Ashland Lakefront Property & Contaminated Sediments

Remediation Action Options Feasibility Study

Ashland, Wisconsin

SEH No. WIDNR9401

December 1998

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December 10, 1998

RE: Ashland Lakefront Property & Contaminated Sediments
Remediation Action Options Feasibility Study
Ashland, Wisconsin
SEH No. WIDNR9401

Mr. James R. Dunn, District Hydrogeologist
Wisconsin Department of Natural Resources
810 W. Maple Street
Spooner, WI 54801

Dear Mr. Dunn:

Short Elliott Hendrickson Inc. is submitting 20 copies of the enclosed report titled "Remediation Action Options Feasibility Study – Ashland Lakefront Property & Contaminated Sediments."

SEH appreciates the opportunity to provide WDNR with continuing environmental services on this project. Following your review of this document, we would be happy to meet with you to discuss implementation of a remedy for this site. If you have any questions pertaining to any phase of the project completed to-date, please contact me.

Sincerely,

Cyrus W. Ingraham, P.E.
Project Manager

MJB/ls/CWI
c: Tom Janisch, WDNR
P:\proj\widnr\9401\rep\rao-fs.rep.wpd

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Remediation Action Options Feasibility Study

Ashland Lakefront Property & Contaminated Sediments
Ashland, Wisconsin

Prepared for:
Wisconsin Department of Natural Resources

Prepared by:
Short Elliott Hendrickson Inc.
421 Frenette Drive
Chippewa Falls, WI 54729
(715) 720-6200

I, John E. Guhl, hereby certify that I am a Hydrogeologist as that term is defined in s. NR 712.03(1) Wis. Adm. Code, and that, to the best of my knowledge, all of the information contained in this document is correct and the document was prepared in compliance with all applicable requirements in chs. NR 700 to 726, Wis. Adm. Code.

John E. Guhl 120 12/10/98

John E. Guhl, P.G. P.G. Number Date
Hydrogeologist

I, Gloria C. Chojnacki, hereby certify that I am a scientist as that term is defined in s. NR 712.03(3), Wis. Adm. Code, and that, to the best of my knowledge, all of the information contained in this document is correct and the document was prepared in compliance with all applicable requirements in chs. NR 700 to 726, Wis. Adm. Code.

Gloria C. Chojnacki 12-10-98

Gloria C. Chojnacki, CHMM Date
Environmental Scientist

I, Mark J. Broses, hereby certify that I am a registered professional engineer in the State of Wisconsin, registered in accordance with the requirements of ch. A-E 4, Wis. Adm. Code; that this document has been prepared in accordance with the Rules of Professional Conduct in ch. A-E 8, Wis. Adm. Code; and that, to the best of my knowledge, all information contained in this document is correct and the document was prepared in compliance with all applicable requirements in chs. NR 700 to 726, Wis. Adm. Code.

Mark J. Broses 31176 12-10-98

Mark J. Broses, P.E. P.E. Number Date
Project Engineer

Executive Summary

Introduction

Short Elliott Hendrickson Inc. (SEH) has completed a Remediation Action Options Feasibility Study (FS) for the Ashland Lakefront Property and adjacent contaminated sediments for the Wisconsin Department of Natural Resources (WDNR).

Site Limits

This FS focused on remedial actions to address the shallow soil, groundwater, and sediment contamination that has been identified above the Miller Creek aquitard. Areal boundaries include the railroad to the south of the site, Prentice Avenue to the east, Ellis Avenue to the west, and the limits of contaminated sediments adjacent north of the shoreline. This FS does not address contamination identified up gradient at the former MGP and ravine, or the deep contamination in the lower Copper Falls aquifer. This FS does not address the potentially contaminated area east of Prentice Avenue.

Site Background

The Ashland Lakefront Property was created anthropogenically in the late 1800's and early 1900's by placement of various fill materials into Chequamegon Bay. The site was owned by various lumber companies until 1936. Fill materials consist largely of wood slabs, pieces, and sawdust mixed with earthen fill. The area immediately south of the Ashland Lakefront Property consists of a railroad right-of-way and a 30-foot high bluff. A manufactured gas plant (MGP) operated at the top of the bluff from the late 1800's until approximately 1947. During the time the MGP operated, a former ravine extending from the MGP site through the bluff to the southern edge of the Ashland Lakefront Property was filled.

Chequamegon Bay is located immediately to the north of the Ashland Lakefront Property. A marina jetty (Ellis Avenue Marina) located at the northwest corner of the property, and two jetties protecting a public boat landing form a small embayment immediately north of the Ashland Lakefront Property. The near shore sediments generally consist of a relatively thin layer of unevenly distributed wood chips underlain by sands and silty sands.

Widespread volatile organic compound (VOC) and semi-volatile organic compound - polynuclear aromatic hydrocarbon (PAH) contamination has been identified at the Ashland Lakefront Property, in the up gradient ravine area, in offshore sediments, and in a deep confined aquifer beneath the former MGP site. The MGP has been identified as a likely source of VOC and PAH contamination in the ravine area, the deep aquifer, the Ashland Lakefront Property, and the offshore sediments. Other sources of VOC and PAH contamination may exist as well but definitive evidence of other major sources has not been identified to-date.

Historical site maps reveal an open sewer extending across the west side of the Ashland Lakefront Property was present until 1951. Relatively high concentrations of VOC and PAH contaminants are present in groundwater collected from the proximity of the former open sewer. This may indicate the former open sewer acted as a conduit for contaminant movement from the south side of the Ashland Lakefront Property into Chequamegon Bay and the associated near shore sediments.

A Baseline Human Health Risk Assessment (HHRA) and Baseline Ecological Risk Assessment (ERA) were conducted earlier this year. The HHRA and ERA concluded that significant risks to human health and the environment are posed by the VOC and PAH contaminants.

Remedial Action Objectives

The following remedial action objectives were identified in order to guide the development of the remedial actions:

- Minimize potential risk to human health and the environment from exposure to contaminants.
- Limit future offsite migration of contaminants.
- Limit future onsite migration of contaminants from up gradient and lateral contiguous properties.
- Implement remedial action that will accommodate future development and beneficial public use of the site.
- Implement remedial action that will be compatible with future activities at contiguous properties and not directly nor indirectly cause deterioration of contiguous properties.

Cleanup Goals

For the purpose of this FS, cleanup goals for the groundwater and soils were based on ch. NR 140 enforcement standards (ES), and ch. NR 720 residual contaminant limits (RCLs).

No regulatory standards have yet been promulgated for sediment quality. For the purposes of this FS, the sediment cleanup goals were based on the toxicity units approach developed in the ERA. The initial goal was established at 10 HA-28 NOC toxic units, which generally correlates to a total PAH concentration between 2500 and 3000 μg/kg (dry weight basis) and 80 μg/g TOC (total organic carbon normalized basis).

Site specific cleanup goals may be established once the remedial action option has been selected.

General Response Actions

General response actions are broad categories of activities and technologies that may be applied alone or in combination to accomplish the remedial action objectives. Several technologies were evaluated under the following general response actions:

Institutional Controls	Access Restrictions	Engineering Controls
In Situ Treatment	Excavation – Landside	Sediment Dredging
Physical Separation	Solids Dewatering	Transportation
Ex Situ Solids Treatment	Off-gas Treatment	Ex Situ Process Incorporation/Co-treatment
Off Site Disposal	Water Treatment	Water Disposal

Remedial Action Options

Nine options were assembled from the general response actions. The options range in complexity from “no further action” to “in situ remediation” to “complete removal”. The options evaluated include:

- **Option A1** – No Further Action
- **Option B1** – Access Restrictions and Institutional Controls
- **Option C1** – Engineering Controls/Confinement/Thick Sediment Cap/Extend Shoreline to 2900N
- **Option C2** – Engineering Controls/ Confinement/ Armored Sediment Cap
- **Option D1** – Engineering Controls/Confinement/Thick Sediment Cap/In Situ Remediation/ Extend Shoreline to 2900N
- **Option D2** – Engineering Controls/Confinement/Nearshore Confined Treatment Facility for Sediments/In Situ Remediation/Extend Shoreline to 2500N
- **Option E1** – Engineering Controls/Confinement/Removal with Ex Situ Treatment and Backfill
- **Option E2** – Engineering Controls/Confinement/Removal and Ex Situ Disposal/New Backfill
- **Option E3** – Engineering Controls/ Confinement/Removal and Ex Situ Disposal/No Backfill

Evaluation & Comparison

The remedial action options were evaluated according to the technical and economic feasibility criteria outlined in s. NR 722.07(4).

A numerical scoring system was utilized to compare the options for each evaluation criteria. The scoring system provided a balanced approach to give equal weight to each of the six technical and economic criteria. A score from 1 to 10 was assigned for each criteria, 1 being the best and 10 being the worst. The best possible total score was 6 and the worst possible total score was 60. A summary of the evaluation is provided below:

Option:	A1	B1	C1	C2	D1	D2	E1	E2	E3
Long-term effectiveness	10	8	6	6	4	4	2	2	2
Short-term effectiveness	10	8	2	2	4	6	6	6	6
Implementability	10	10	6	6	4	4	4	6	8
Restoration Time Frame	10	10	8	8	4	4	2	2	2
Costs ($, million)	(0) 1	(4M) 1	(28M) 3	(24M) 3	(40M) 4	(51M) 5	(93M) 9	(89M) 9	(79M) 8
Potential Future Liability	10	10	6	6	4	4	2	4	4
Total	51	47	31	31	24	27	25	29	30

Criteria Score: 2 = Very Good, 4 = Good, 6 = Medium, 8 = Poor, 10 = Very Poor

Best Score, cost included

Recommendation

The in situ remediation options D1 and D2 have the lowest costs of the apparently most feasible options. SEH recommends that the WDNR consider the D1 and D2 options for implementation at this site.

Implementation

The WDNR will meet with responsible parties, the community, and other stakeholders to select the remedial alternative. Following selection of the alternative, completion of design studies, permit approvals, construction plans and specifications, and bidding may require two years prior to initiation of the remedy at the site.

List of Abbreviations

Abbreviations used in Feasibility Study

ARAR	Applicable or Relevant and Appropriate Requirement
ASTM	American Society of Testing Materials
BETX	Benzene, Ethylbenzene, Toluene, and Xylene
bgs	below ground surface
BTU	British Thermal Unit
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
ch. NR 140	WAC Chapter Natural Resources 140 - Groundwater Quality
ch. NR 720	WAC Chapter Natural Resources 720 - Soil Cleanup Standards
ch. NR 722	WAC Chapter Natural Resources 722 - Standards for Selecting Remedial Actions
CFR	Code of Federal Regulations
CHMM	Certified Hazardous Materials Manager
CTE	Central Tendency Exposure
D&M	Dames & Moore Inc.
DCOM	Wisconsin Department of Commerce
DHFS	Department of Health and Family Services - State of Wisconsin
DNAPL	Dense Non Aqueous Phase Liquid
DW	Dry Weight
EPA	Environmental Protection Agency (USEPA)
ERA	Ecological Risk Assessment
ERM	Effects Range - Median
EIS	Environmental Impact Statement
ES	ch. NR 140 Enforcement Standard
FS	Feasibility Study for Remedial Action Options
GLI	Great Lakes Initiative
HA-28	*Hyallela azteca* 28 day Toxicity Test
HEAST	Health Effects Assessment Summary Tables
HHRA	Human Health Risk Assessment
IRIS	Integrated Risk Information System
LNAPL	Light Non Aqueous Phase Liquid
mg/kg	milligram/kilogram
mg/l	milligram/liter
MGP	Manufactured Gas Plant
MSL	Mean Sea Level
NAPL	Non Aqueous Phase Liquid
NCP	National Oil and Hazardous Substance Pollution Contingency Plan
NET	Northern Environmental Technologies Inc.
NOAA	National Oceanic and Atmospheric Administration
NOC	Normalized to Organic Carbon
NSE	No Standard Established
NSP	Northern States Power Company
OMM	Operations Maintenance and Monitoring

ORNL	Oak Ridge National Lab
PAH	Polynuclear Aromatic Hydrocarbons
PE	Professional Engineer
PEL	Probable Effects Level
PG	Professional Geologist
ppb	parts per billion
PPE	Personal Protective Equipment
ppm	parts per million
RCL	ch. NR 720 Residual Contaminant Level
RCRA	Resource Conservation and Recovery Act
RME	Reasonable Maximum Exposure
SEH	Short Elliott Hendrickson Inc.
SVE	Soil Vapor Extraction
TBC	To Be Considered
TCLP	Toxicity Characteristic Leaching Procedure
TOC	Total Organic Carbon
TPAH	Total Polynuclear Aromatic Hydrocarbons
TSCA	Toxic Substances Control Act
TSS	Total Suspended Solids
TU	Toxic Units
μg/kg	microgram/kilogram
μg/l	microgram/liter
USEPA	United States Environmental Protection Agency
UV	ultraviolet
VOC	Volatile Organic Compound
WAC	Wisconsin Administrative Code
WDNR	Wisconsin Department of Natural Resources
WPDES	Wisconsin Pollution Discharge Elimination System
WWTP	Wastewater Treatment Plant

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Remediation Action Options Feasibility Study

Ashland Lakefront Property & Contaminated Sediments

Prepared for Wisconsin Department of Natural Resources

1.0 Introduction

This Remediation Action Options Feasibility Study (FS) report was prepared for the Wisconsin Department of Natural Resources (WDNR) by Short Elliot Hendrickson Inc (SEH) in accordance with our October 11, 1997 contract.

1.1 Purpose

A comprehensive FS was performed to identify potential remedial action options to mitigate risks associated with contamination identified at the Ashland Lakefront Property and adjacent offshore sediments.

1.2 Scope of Work

The FS was conducted in accordance with Wisconsin Administrative Code (WAC) ch. NR 722 "Standards for Selection Remedial Actions" and in general accordance with the National Oil and Hazardous Substance Pollution Contingency Plan (NCP), 40 CFR Part 300.430(e) and (f) which outline the requirements of an FS and the selection of a remedy under CERCLA. The key components of the FS include:

- definition of remedial action objectives and limits
- evaluation of applicable or relevant and appropriate requirements (ARARs)
- identification of potential remedial technologies
- screening of technologies
- development and evaluation of remedial action options alternatives

- comparison of alternatives
- identification of the most feasible remedial alternatives

2.0 Background Information

2.1 Site Location and Description

The Ashland Lakefront Property (site) is located in Section 33, Township 48 North, Range 4 West in Ashland County, Wisconsin as shown in Figure 1, "Site Location." The latitude and longitude of the property is 46°35'41" North and 90°53'01" West. As shown on Figure 2, "Site Features" the site is located in an active community surrounded by residences, schools, hotels, and public recreation areas.

The site is bounded by Prentice Avenue to the east, the Wisconsin Central Railroad Line to the south, and Ellis Avenue to the west, as shown on Figure 3, "Site Limits." The site includes an offshore area to the north in Chequamegon Bay.

The Ashland Lakefront Property was created anthropogenically in the late 1800's and early 1900's by placement of various fill materials into Chequamegon Bay, which extended the original shoreline out approximately 400 feet to the north. The fill materials consisted primarily of wood slabs, pieces, and sawdust mixed with earthen fill. Some solid waste fill (e.g., bottles, brick, concrete pieces) is also present at various site locations.

The property currently consists of a city park (Kreher Park), comprised predominantly of mowed grass areas. A low brushy area is present on the south side of the property, and the building and structures from a former wastewater treatment plant (WWTP) are located on the north side of the property. A miniature golf course has recently been constructed on the east side of the property.

A marina jetty extends to the north off the western edge of the property, and two jetties protecting a public boat landing extend to the north off the east edge of the property. These jetties form a somewhat protected embayment directly to the north of the Ashland Lakefront Property.

The offshore sediments adjacent to the Ashland Lakefront Property generally consist of a surficial layer comprised of wood chips underlain by sand and silty sand sediments. The layer of wood chips ranges from 0 to seven feet in thickness, with an average thickness of approximately 9 inches. Some larger wood slabs and pieces have been observed at some locations. Some areas largely devoid of wood chips have also been observed in this area.

2.2 Upper Bluff Area

The area immediately south of the Ashland Lakefront Property consists of a railroad right of way, and a 30 foot high bluff. The property on this portion of the upper bluff historically has been occupied by residential, commercial, and industrial development. A former manufactured gas plant (MGP) is located at the southwest corner of the intersection of Prentice Avenue and St. Claire Street.

A ravine historically extended from the former MGP site northward through the upper bluff to the southern edge of the Ashland Lakefront Property. This was a naturally occurring drainage feature formed by flow of surface water to the north into Chequamegon Bay. The ravine was formed by erosion of surficial soils over time. The ravine was filled some time between 1901 and 1923 based on review of historical Sanborn Fire Insurance Maps.

Several utility lines lead from the upper bluff area through the Ashland Lakefront Property to the former WWTP. A significant discharge of water presently occurs from a storm water pipe at the base of the bluff on the western portion of the site.

2.3 Current and Future Land Use Conditions

Area demographic information, provided by the City of Ashland, indicates that the city population has been decreasing over the past 20 to 30 years but has stabilized recently at 8,979 residents based on January 1997 data. The area west of the lakefront property is mostly commercial with several hotels, the City marina and a power plant. The area south and east of the lakefront property is densely residential. Homes and occupants in the neighborhood are generally older and occupancy turnover is relatively infrequent. Our Lady of the Lake, a preschool through grade 8 school exists less than three blocks to the south of the lakefront property.

At this time, the Ashland Lakefront Property site is zoned CR, Conservancy District. One of the acceptable uses for this designation is as parkland. The area is readily accessed by the public and a majority of the site is mowed and maintained for public usage. An artesian well is located near Prentice Avenue on the eastern boundary of the site. Another artesian well is located near the marina on the western boundary of the site. The artesian wells are available for the public to fill containers for drinking water. The water from the artesian wells originates from the deep (Copper Falls) confined aquifer located beneath the site. There are restriction signs posted at the seep area, the lake and former waste water treatment plant warning against entry or swimming. A fence prevents entrance to the former waste water treatment plant and seep areas. However, no physical barrier exists at the shoreline to prevent swimming or wading.

Based on the discussion with the City Engineer and the "Ashland Wisconsin Waterfront Development Plan" (Discovery Group Ltd, undated), the City has future plans to expand the RV park which is immediately adjacent to the Ashland Lakefront Property to the east. Kreher Beach exists east of the former WWTP and boat landing and north of the RV park. Life guards are posted at Kreher Beach for seasonal swimming. Currently, a miniature golf course facility exists at the southwest intersection of Prentice Avenue and Marina Drive in Kreher Park. The City of Ashland marina immediately west of the Ashland Lakefront Property, the RV park, Kreher Beach and boat landing and the golf coarse are heavily used during the summer months. Further recreational development of the Ashland Lakefront Property has been discussed by the City of Ashland including amenities such as parking, etc. which accompanies increased usage. Based on discussion with the City Engineer, the City has been opposed to commercial or residential development of the property.

Chequamegon Bay is now an important recreational resource in the northern Wisconsin region. The bay receives significant usage from pleasure boaters, fishermen, swimmers, snowmobilers, and outdoorsmen.

2.4 Site History

The Ashland Lakefront Property was created in the late 1800's and early 1900's by placement of various fill materials into Chequamegon Bay which extended the former shoreline approximately 400 feet to the north. From the late 1800's until 1936 the site was owned by various lumber companies, including Barber Mill, W. R. Sutherland Mill, Pope Lumber, and John Schroeder Lumber. Lumber processing operations on the site had ceased, for the most part, by 1930. A number of individuals interviewed recall creosote wood treatment operations historically occurring in the vicinity of the site. However, no physical evidence of wood treatment facilities (e.g., historical maps, evidence of pits or tanks), has been identified on the site to-date. Ashland County assumed ownership of the site in 1936, and the City of Ashland has since acquired the site property.

As described previously, a MGP was previously located on the current NSP property on the bluff to the south of the site. The MGP plant operations began sometime prior to 1886 and ended in approximately 1947. NSP acquired the property from LSDP in 1982. Structures historically located on the MGP site included gas holders, aboveground and underground naphtha tanks, oil tanks, gasol storage tanks, and purifiers. Secondary by-product materials were typically generated from MGPs (i.e., coal tar, polynuclear aromatic hydrocarbons (PAHs), pitch, light oils, volatile organic compounds (VOCs), and coal gas purifier wastes). Records are incomplete pertaining to the volumes of gas manufactured as well as the disposition of the secondary by-product materials.

Prior to being filled in sometime between 1901 and 1923, a ravine historically ran from the MGP property, through the bluff, to the site. The ravine was a natural erosional feature which historically discharged surface water from the upper bluff area to Chequamegon Bay. Based on historical maps of the vicinity, the ravine was located east of North 3rd Avenue. The approximate location of the former ravine is depicted on Figure 2.

A 2" tar pipe has been identified on an historic (1951) set of site drawings running from the former MGP property toward the Ashland Lakefront Property. The 2" pipe aligns with an historic "Waste Tar Dump" depicted at the Ashland Lakefront Property on the same set of site drawings. Additionally, a former open sewer ran across the western side of the park from 1901 until some time after 1951.

The WWTP for the City of Ashland was constructed on the site in 1951 and expanded in 1973. The WWTP has not been operated for several years. A clay core wall was constructed along the north and west boundaries of the WWTP to prevent lake water from infiltrating the facility. Based on borings performed by SEH, the clay core wall appears to be separated from the underlying Miller Creek soils by a layer of sand located 12 to 13 feet below ground surface (SEH boring TW-11). This and layer may act as a hydraulically conductive conduit between the Ashland Lakefront Property and Chequamegon Bay at this location.

Historically, Chequamegon Bay has been utilized as an important commercial transportation route since the 1800's. Products and materials shipped to and from the Ashland area on Chequamegon Bay included iron ore, coal, pulpwood, and saw logs. In addition, logs were floated in to the Ashland area on Chequamegon Bay in the late 1800's and early 1900's for processing. A dredged shipping channel has been maintained in the bay since the late 1800's. The volume of commercial shipping on the bay has greatly decreased since the Upper Peninsula iron mining industry and northern Wisconsin lumbering industries have diminished.

A commercial dock formerly extended into Chequamegon Bay from the west end of the Ashland Lakefront Property. This dock was used for bringing wood materials to the lumber mills that were formerly located on the property. A log boom also historically extended into the bay from the north end of the property. The log boom was used to extract the floating logs from the bay for processing at the lumber mills.

2.5 Previous Studies and Reports

Contamination was identified on the Ashland Lakefront Property during an 1989 environmental assessment of the former WWTP. Since then, several investigations have been conducted to determine the extent of contamination in the vicinity of the site. Extensive contamination has been identified at the Ashland Lakefront Property, in the adjacent sediments, and up gradient in the ravine and in the vicinity of the former MGP. Contamination of the deep confined Copper Falls aquifer has also been identified beneath the former MGP.

The following reports prepared previously by SEH and Northern Environmental Technology (NET) summarize the investigative activities at and around the site, as well as evaluations of potential risks and remedial actions:

- Environmental Assessment Report - City of Ashland WWTP Site (NET, August 1989)
- Report of Test Pits at the Ashland WWTP (NET, September 1991)
- Remedial Investigation Interim Report - Ashland Lakefront Property (SEH, July 1994)
- Existing Conditions Report - Ashland Lakefront Property (SEH, February 1995)
- Draft Remediation Actions Options Feasibility Study - Ashland Lakefront Property (SEH, February 1996)
- Sediment Investigation Report - Ashland Lakefront Property (SEH, July 1996)
- Comprehensive Environmental Investigation Report - Ashland Lakefront Property (SEH, May 1997)
- Supplemental Investigation Report - Ashland Lakefront Property (SEH, March 1998)
- Baseline Human Health Risk Assessment - Ashland Lakefront Property (SEH, June 1998)
- Ecological Risk Assessment - Ashland Lakefront Property Contaminated Sediments (SEH, October 1998)

Additionally, the following reports were produced by Dames & Moore Inc. (D&M) for NSP to evaluate the up gradient contamination associated with the former MGP.

- Final Report - Ashland Lakefront/NSP Project (D&M, March 1995)
- Draft Site Investigation Report and Remedial Action Plan for NSP (D&M, June 1995)

- Supplemental Groundwater Investigation Final Report for NSP (D&M, August 1996)
- Copper Falls Aquifer Groundwater Investigation for NSP (D&M, February, 1997)
- Remedial Action Plan - Lower Copper Falls Formation Aquifer for NSP (D&M, April 1998)

2.6 Physical Characteristics

2.6.1 Topography

The Ashland area is located in the Lake Superior Lowland physiographic province characterized by flat to undulating topography underlain by red glacial clay. Uplands lie to the south of Ashland and are characterized by rolling hilly topography and underlain by sand and gravel soils. Elevations in the Ashland area range from 601 feet MSL datum to approximately 700 feet MSL. Regional slope is generally to the north.

The Ashland Lakefront Property is a relatively flat terrace located below a 30 foot high lake bluff. Elevations of the terrace range from 601 MSL to approximately 610 MSL. The elevation of the upper bluff in the vicinity of the former ravine area is approximately 640 feet MSL.

2.6.2 Surface Water

The Ashland Lakefront Property is located on the shore of Chequamegon Bay. Regional surface water drainage flows to the north through Fish Creek and several small unnamed creeks and swales into Chequamegon Bay. Surface water at the site and in the upper bluff area flows either to the City of Ashland storm sewer system, or discharges directly to Chequamegon Bay.

The water depth over the contaminated sediments ranges from 0 to 12 feet. Waves up to five feet have been observed when winds are from the northwest, and may be greater during storm events. The surface water elevation in Chequamegon Bay fluctuates between 601 and 603 MSL over time.

2.6.3 Geology

Soils in the Ashland area generally consist of surficial deposits underlain by red clay and silt deposits of the Miller Creek Formation. Thickness of the Miller Creek soils in the Ashland area ranges from approximately 15 to 50 feet based on local well logs. Miller Creek soils are underlain by interbedded glacial clays, sands and gravels of the Copper Falls Formation. Thickness of the Copper Falls Formation is at least 130 feet based on local well logs.

Precambrian aged sandstone of the Oronto Group is likely the uppermost bedrock unit in the Ashland area. Thickness of the sandstone unit has not been determined. The Oronto sandstones are most likely underlain by Precambrian basalt.

Surficial soils at the Ashland Lakefront Property are underlain by a variety of fill materials, including wood waste (slabs and sawdust), solid waste (including concrete, bricks, bottles, glass, steel pieces, wire, and cinders), and earthen fill (including a buried clay berm along the shoreline on the northeast side of the site). Fill materials are underlain in places by a 0 to 5.5 foot thick layer of beach sand. Soils of the Miller Creek Formation are present below the fill and beach sand. The Miller Creek soils encountered at the Ashland Lakefront Property consist of clays and silts and range in thickness from 7 to 40 feet. Silty sand and gravel soils of the Copper Falls Formation are present beneath the Miller Creek soils. Thickness of the Copper Falls Formation at the site has not been determined. Bedrock has not been encountered to-date during investigation of the site.

Geology of the upper bluff area in the vicinity of the former ravine consists of earthen fill materials in the former ravine, with clay soils of the Miller Creek Formation on the flanks of the former ravine. Miller Creek clay soils are present at the base of the former ravine, however, the thickness of these soils has been measured at as little as four feet at one soil boring location. It is unknown whether the Miller Creek Formation exists along the entire base of the former ravine. Sand and gravel layers interbedded with silty clay lenses were encountered below the Miller Creek Formation.

Offshore geology adjacent to the site consists of a discontinuous layer of submerged wood chips on the lake bottom underlain by fine to medium grained sand sediments. The sand sediments are underlain by silts and clays of the Miller Creek Formation. The Copper Falls Formation was not encountered during investigation of offshore sediments. A geologic cross section shown on Figure 2 depicts subsurface geologic conditions in the areas of investigation.

2.6.4 Hydrogeology

A shallow saturated zone is typically found above the contact of the Miller Creek Formation and the overlying surficial soils. Thickness of this shallow saturated zone can locally be up to ten feet, but it is not commonly used as a water supply source. Three aquifers occur in the Lake Superior Basin in the vicinity of Ashland; the Pleistocene sand and gravel aquifer (referred to herein as the Copper Falls aquifer), the Precambrian sandstone aquifer, and the Precambrian basalt aquifer.

The Copper Falls aquifer occurs at approximately 25 to 55 feet below ground surface in the Ashland area. Sandy till units within the aquifer yield low volumes of water (5 to 10 gpm), while sand and gravel lenses can yield up to 100 gpm. The Copper Falls aquifer is confined by the overlying cohesive Miller Creek soils. The Miller Creek Formation functions as an aquitard or confining unit hydraulically separating the shallow saturated zones and the Copper Falls aquifer. Wells screened in the Copper Falls aquifer frequently exhibit artesian conditions in the Ashland area, particularly close to the Chequamegon Bay shoreline. Static heads of more than 30 feet above the surface of Lake Superior have been reported at some locations along the Ashland shoreline. Thickness of the Copper Falls aquifer is over 100 feet based on deep piezometer boring information from site investigation.

The Precambrian sandstone aquifer is utilized as a municipal water supply source in several nearby communities (e.g., Washburn, Bayfield). Moderate to low permeabilities exist within the sandstone aquifer. Sandstone wells in the Ashland area typically yield between 5 and 50 gpm.

The Precambrian basalt aquifer produces moderate to low yields of groundwater. Yields are typically controlled by fracture densities within the bedrock. The basalt aquifer is commonly used as a water supply source south of Ashland where the aquifer occurs closer to the surface.

A shallow saturated zone is present within the soils and fill materials overlying the Miller Creek Formation at the Ashland Lakefront Property. The hydraulic conductivity of the shallow soils and fill materials ranges from approximately 0.1 to $5x10^{-5}$ cm/sec. The higher hydraulic conductivity values are typically found in locations with saturated wood waste fill. The horizontal hydraulic gradient is very flat (0.001 ft/ft to the north) due to the high hydraulic conductivities in the shallow soils at the Ashland Lakefront Property. Artesian conditions are present at the site in the Copper Falls aquifer. Head levels of approximately 17 feet above ground surface have historically been measured in an artesian well located on the Ashland Lakefront Property, indicating a strong upward gradient at this location.

Hydrogeology of the upper bluff includes low permeability conditions ($3x10^{-6}$ to $4x10^{-8}$ cm/sec) in the Miller Creek clays comprising most of the shallow saturated soil in the area. Fill soils located in the former ravine exhibit hydraulic conductivities approximately 1,000 times higher than the surrounding Miller Creek soils. Horizontal hydraulic gradient in the fill soils of the former ravine is approximately 0.09 ft/ft. Direction of groundwater flow in this location is to the north (toward the mouth of the former ravine).

Groundwater flows onto the ground surface at the base of the bluff in the proximity of the mouth of the former ravine in the form of a seep. Investigation of the seep area has revealed a significant mound of the groundwater table at this location. Water appears to move radially away from the seep in all directions. Consequently, it does not appear likely that unconfined water could be moving through shallow soils from the upper bluff area to provide the surface discharge which is ongoing at the seep. Three potential explanations for this phenomenon include:

- A pipe of some type could be a conduit of water, transmitting water to the seep location from an up gradient location with a higher static head.
- A breach in the Miller Creek soils could potentially be present at this location, allowing upwelling of artesian water from the Copper Falls aquifer to the surface at the seep location.
- The apparent mound could be connected to a higher static head to the east and then south of the seep (no monitoring points have been installed to-date immediately east of the seep).

Based upon review of available data, it appears that water transmission via a pipe is the most plausible explanation for the occurrence of groundwater mounding in the vicinity of the seep.

Artesian conditions have not been identified in the Copper Falls aquifer in the vicinity of the former ravine area or the upper bluff area. An upward hydraulic gradient is present in the Copper Falls aquifer in the northern portion of the upper bluff area, and diminishes and eventually changes to a downward gradient to the south. The general direction of flow in the Copper Falls aquifer is to the north (toward Chequamegon Bay).

2.7 Nature and Extent of Contamination

Soil, groundwater, and sediment sample analysis has historically been utilized to define the degree and extent of subsurface contamination. In addition, observations of the presence or absence of non-aqueous phase liquids (NAPLs) have been made by SEH in several monitoring wells and piezometers. Detailed discussion of the analytical results for the site are presented in the previously listed reports. This section briefly discusses those results and also includes the results of TCLP sampling recently conducted at the site.

2.7.1 Soils

Soils at the Ashland Lakefront Property and in the former ravine area have been impacted by a variety of contaminants, including volatile organic compounds (VOCs), polynuclear aromatic hydrocarbons (PAHs), and metals. The VOCs detected are predominantly comprised of benzene, Ethylbenzene, toluene, and xylene (BETX) compounds and naphthalene. PAH compounds detected include most of the compounds analyzed on the EPA SW 846 8260 scan. Lead and arsenic were detected in some soil samples at elevated concentrations relative to background. Numerous accedences of existing and proposed ch. NR 720 soil cleanup standards for VOCs and PAHs were noted.

The extent of VOC and PAH impacted soils approximates the area of shallow groundwater BETX contamination depicted on Figure 3.

Widespread VOC contamination has been identified in the shallow soils at the Ashland Lakefront Property and in the former ravine area. The VOCs consist predominantly of the BETX compounds as well as naphthalene. However, since naphthalene is also included as a parameter in the PAH range, naphthalene contamination will be discussed only in the PAH subsections to avoid redundancy. In addition, several areas of apparent grossly contaminated soils (e.g., "coal tar saturated soils" in Dames and Moore borings B-19 and B-20) which were not analyzed for total concentrations of VOCs (TCLP analysis was performed) were identified during investigation of the former ravine area. No TCLP exceedances for VOCs were identified in the soils analyzed from the former ravine area.

SEH collected a sample from the seep and a composite sample from the park for TCLP analysis for benzene. No TCLP exceedance was identified for either sample. The location of the samples is shown on Figure 4, "Treatability Study Sampling Locations." The analytical results are summarized in Table 1, "TCLP Results," and laboratory reports are provided in Appendix A, "Analytical Results."

A wide range of PAH soil contaminants have been identified in shallow soil samples analyzed from the Ashland Lakefront Property and the former ravine area. PAH soil contamination generally begins near the shallow groundwater surface, and extends to the top of the Miller Creek Formation. The horizontal extent of shallow PAH impacted soils includes the soils in the former ravine area, and soils on the Ashland Lakefront Property extending north to the shoreline of Chequamegon Bay.

Metals contamination identified in the vicinity of the Ashland Lakefront Property includes scattered, potentially isolated areas of elevated lead concentrations. In addition, one soil sample analyzed from the site contained elevated concentrations of arsenic. These concentrations appear to be elevated above the natural levels of metals in the soils of Wisconsin. The scattered areas of metals contamination appear to be most prevalent along the northern portion of the Ashland Lakefront Property. One soil sample collected from the former ravine area contained concentrations of TCLP lead exceeding the TCLP standard for lead. TCLP samples collected by SEH in the park did not exceed the TCLP standards for lead or arsenic.

2.7.2 Groundwater

Groundwater at the Ashland Lakefront Property, in the former ravine area, and in the Copper Falls aquifer have been impacted by a variety of contaminants. A variety of VOCs (predominantly BETX compounds and naphthalene), PAHs, and metals (lead, iron, and manganese) were detected in groundwater samples collected during the investigation. Numerous exceedances of ch. NR 140 groundwater standards have been identified.

The areal extent of shallow contamination at the Ashland Lakefront Property and in the former ravine area is depicted on Figure 3. The approximate vertical extent of contamination is depicted in cross section on Figure 3.

In addition, it is apparent that the distribution and concentration of groundwater contaminants is influenced by the presence of NAPL in the subsurface. A detailed discussion of NAPL contamination is presented in Section 2.7.3 of this report.

The groundwater analysis performed during investigation of the Ashland Lakefront Property and vicinity indicates the presence of widespread VOC groundwater contamination. Exceedances of ch. NR 140 Enforcement Standards (ES) for BETX have been identified at widespread locations in the vicinity. The VOCs most commonly detected in the shallow groundwater at the Ashland Lakefront Property include benzene, Ethylbenzene, and xylene.

A wide range of PAH contaminants has been identified during the groundwater investigations of the vicinity. Exceedances of ch. NR 140 ESs for naphthalene and benzo(a)pyrene have been identified at widespread locations of the investigated area. Generally, the most prevalent PAH compound in the areas of impacted groundwater at the Ashland Lakefront Property, the former ravine area, and in the Copper Falls aquifer is naphthalene.

Several dissolved metals were detected at widespread locations during the groundwater investigations. Numerous ch. NR 140 ES exceedances were identified for iron. In addition, ch. NR 140 Preventive Action Limit (PAL) exceedances were identified in one or more groundwater samples for arsenic, cadmium, and lead. The distribution of dissolved metals in groundwater appears to be scattered, and does not appear to correlate with the distribution of groundwater VOC and PAH contaminants.

2.7.3 Non-Aqueous Phase Liquids

Significant quantities of DNAPL were detected in piezometers MW-13A, MW-13B, and in monitoring wells TW-9 and MW-7. Piezometers MW-13A and MW-13B are located in the upper bluff area on St. Claire Street and are screened in the Copper Falls aquifer. Monitoring wells TW-9 and MW-7 are located at the base of the bluff on the Ashland Lakefront Property and are screened in the shallow saturated zone.

Approximately 2.1 feet of DNAPL was measured in piezometer MW-13A. Piezometer MW-13A is screened 45 feet below ground surface (bgs). The borehole for MW-13A was advanced to a depth of 50 feet bgs. Approximately 26 feet of DNAPL was measured in piezometer MW-13B. The geologic and well construction logs for this well indicate the borehole was advanced and the well completed at a depth of 70 feet bgs.

The DNAPL was detected at the bottom of piezometers MW-13A and MW-13B. A distinct phase separation (i.e., water-product) was evident in these piezometers. The water column above the DNAPL was relatively clear and apparently free of product. The DNAPL sampled in each of these piezometers consisted of a black, oily, low to medium viscosity (thin), highly odorous hydrocarbon material. Considerable staining of the white PVC casing at piezometers MW-13A and MW-13B occurred during the NAPL evaluation. The lack of residual DNAPL on the inside of the well casings prior to SEH's evaluation indicates the presence of DNAPL in these piezometers may not have previously been identified.

DNAPL was also measured in monitoring wells TW-9 and MW-7 located at the base of the former ravine area on the Ashland Lakefront Property. Approximately 2 feet of DNAPL was measured in well TW-9. This well is screened from 4 to 14 feet below ground surface. Approximately 5 feet of DNAPL was measured in well MW-7. Well MW-7 is located directly down gradient of the seep area and is screened from 5 to 15 feet below ground surface. The DNAPL measured in wells MW-7 and TW-9 was also found as a separate phase at the bottom of the wells. The apparent physical characteristics (i.e., color, viscosity) of the material observed in wells MW-7 and TW-9 was similar to the DNAPL observed in piezometers MW-13A and MW-13B.

A NAPL emulsion (a mixture of insoluble liquid-droplets and water) was detected in three of the monitoring wells evaluated at the Ashland Lakefront Property. A yellow, low viscosity emulsion was evident on the weighted cotton string and bailer immersed in wells MW-2, MW-3, and TW-6. The emulsion consists of brownish-yellow droplets of hydrocarbon material dispersed throughout the water column in the well. No phase separation was evident in these wells.

The results of SEH's NAPL evaluation clearly indicate the presence of significant quantities of DNAPL in the subsurface of the upper bluff area and the Ashland Lakefront Property. Data collected during previous investigations, including geologic logs for borings advanced in the former ravine area and at the Ashland Lakefront Property, and observations of test pits excavated at the Ashland Lakefront Property, indicate the potential presence of NAPL across other areas of the two sites.

The apparent low viscosity of the DNAPL and emulsified NAPL observed in the monitoring wells and piezometers indicates the potential for significant mobility of NAPLs within the subsurface.

2.7.4 Sediments

Offshore sediments located immediately adjacent to the Ashland Lakefront Property have been impacted by VOCs (predominantly BETX compounds) and by PAH compounds.

The concentrations of sediment contaminants identified adjacent to the Ashland Lakefront Property were compared to the Province of Ontario and NOAA guidelines for several PAHs and metals. Exceedances of Ontario and/or NOAA guidelines for one or more PAH compound were measured in sediment samples collected as far as 700 feet offshore. Exceedances of Ontario or NOAA guidelines were generally not identified for metals. Details regarding the exceedances of these guidelines is presented in the Sediment Investigation Report (SEH, 1996). The extent of sediment contamination is depicted on Figure 3. Downward movement of offshore contamination is limited by the Miller Creek Formation soils.

Generally, the extent of offshore VOC contamination is contiguous with the north shoreline of the Ashland Lakefront Property, forming three undulating lobes that extend up to 700 feet offshore. VOCs were generally not detected in offshore samples collected east of the Kreher Park boat landing or west of Ellis Avenue.

A composite sediment sample and hotspot sediment sample were collected from locations shown on Figure 4 for TCLP analysis for benzene. No TCLP exceedances for benzene were identified in these samples.

A wide range of PAH contaminants were identified in the offshore sediment and soil samples analyzed from adjacent to the Ashland Lakefront Property. The horizontal extent of offshore PAH impacts is approximately the same as that indicated for offshore VOC contamination. Downward movement of offshore PAH contaminants is limited by the Miller Creek Formation soils.

Offshore sediment and soil samples were analyzed for a variety of metals and select parameters, including arsenic, cadmium, chromium, copper, lead, nickel, zinc, and cyanide. The concentrations of metals analyzed were generally below background concentrations identified during previous investigations of pre-colonial Great Lakes sediments. No significant offshore metals contamination has been identified adjacent to the Ashland Lakefront Property.

2.8 Fate and Transport

A detailed evaluation of fate and transport processes is provided in the Comprehensive Investigation (SEH, May 1997). This section presents a brief summary. Based on the results of the investigations performed to-date, NSP and Kreher Park, it is apparent that widespread contamination exists in the project area. The media affected by the contamination includes soil, sediment, surface water, and groundwater. Contaminant releases to air near the site have not been measured to-date, but are likely occurring to a limited extent under existing conditions. Volatile compounds are likely migrating in the vadose zone and venting to the atmosphere. Limited volatilization may also occur from impacted surface water (i.e., Chequamegon Bay and the seep).

VOC and PAH contaminants are found in the ravine fill, shallow groundwater, and the deeper Copper Falls aquifer in the dissolved phase, as an emulsion, and as immiscible liquids (DNAPL). The DNAPL measured in the Copper Falls aquifer may have migrated vertically downward through natural or man-made breaches in the clay aquitard (Miller Creek Formation) in the vicinity of the former ravine area. DNAPL migration in the ravine fill likely occurred along the base of the former ravine area under the influence of gravity. The apparent low viscosity of the DNAPL observed in the piezometers screened in the Copper Falls aquifer and monitoring wells screened in the shallow saturated zone indicates the potential for significant mobility within the subsurface.

Significant VOC and PAH concentrations are present in the dissolved phase in the shallow groundwater as well as in the Copper Falls aquifer. The soluble contaminants in the DNAPL in the deep aquifer will dissolve in groundwater. The dissolved phase contaminants will continue to migrate by advection in groundwater toward the north.

The presence of DNAPL in the shallow unconfined aquifer and ravine fill provide a continuous source of contaminants to groundwater. Dissolved phase contaminants migrate in the ravine fill and shallow unconfined aquifer by advection in groundwater. However, the degree of advective flow in the fill materials below the Ashland Lakefront Property is unknown. Water elevations measured in monitoring wells screened in the fill indicate a very low hydraulic gradient across the site due in part to the open or porous nature of the fill material. It is possible that movement of water within the fill is partially affected by water level fluctuations and water movement in the bay.

The presence of DNAPL was also detected at the base of the shallow aquifer in areas below the Ashland Lakefront Property. In addition, an emulsion consisting of hydrocarbon droplets dispersed in water was detected in several of the wells and test pits at the Ashland Lakefront Property. Constituents in the DNAPL and emulsion will continue to dissolve and contaminate the groundwater below this site.

LNAPLs were not detected in monitoring wells at these sites. However, it is possible that some of the elevated VOC concentrations measured at the site are related to the presence of LNAPLs. If present, LNAPLs would move in the direction of groundwater flow. It should be noted that the presence or absence of NAPL in the aquifer, and the techniques used to sample the groundwater, significantly affect the concentration of contamination detected in the samples as well as the consistency of concentrations from one round of sampling to the next at individual sampling points.

The extent of VOC and PAH contaminated sediment in Chequamegon Bay appears to be confined to the nearshore (within 700 feet) environment north of the Ashland Lakefront Property. The mapped horizontal extent of PAH and VOC contaminated sediment roughly follows the configuration of the north shoreline of the Ashland Lakefront Property. Visual observation sampling and analysis of sediment to the west of the Ashland Lakefront Property and beyond 700 feet north of the north shoreline did not indicate the presence of PAH and VOC contaminated sediment. The mapped distribution of contaminated sediment in the bay is possibly due to periodic resuspension of the sediment caused by bioturbation, wave action, and seiche effect and the lateral transport of contaminants and sediment by longshore or littoral currents.

The physical-chemical characteristics of the constituents of interest detected during the sediment study suggest that concentrations of contaminants in sediments would be higher than the concentrations in the overlying water column. The high specific gravity, low solubility, and affinity for adsorption to sediment will tend to concentrate these contaminants in the sediment. The PAH and VOC contaminated sediment is concentrated at the wood debris/sediment-water interface and concentrations generally decrease with depth. The presence of contaminated sediment and NAPLs across the surface of the lake bed is consistent with the physical-chemical characteristics of the contaminants. The distribution pattern of contaminants in the bay, and the absence of sedimentation above the wood or NAPL contaminated sediment, is consistent with periodic resuspension and redeposition physical processes likely occurring in the bay.

The areal extent of shallow subsurface contamination identified to-date at the Ashland Lakefront Property includes approximately ten impacted acres on the Kreher Park property, one impacted acre up gradient from the site in the former ravine area, and ten acres of impacted offshore sediments. Contamination has also been identified in the Copper Falls aquifer, however, the extent of contamination in this aquifer may require further delineation.

The organic chemistry of contaminants located in the Copper Falls aquifer, former ravine area, Ashland Lakefront Property, and offshore sediments is similar in that the contaminants consist a naphthalene-rich liquid containing a wide spectrum of PAH and VOC compounds. The variations in concentration and distribution of individual PAHs or VOCs are possibly attributable to different waste sources (e.g., MGP wastes vs. wood treatment wastes), historic changes in production processes or waste disposal practices (e.g., MGP switching from coal carbonization to carbureted water gas process), or geochemical or biodegradation processes. In addition, the presence or absence of NAPL along with the well sampling and analytical techniques used likely accounts for some of the temporal and spacial variability observed in groundwater concentration data.

The sources of shallow contamination and offshore contamination in the vicinity of the property have not been definitively identified to-date. The source of shallow contamination (except metals) in the former ravine area appears to be operations of the former MGP. It also appears that contaminated groundwater is migrating onto the Ashland Lakefront Property in the vicinity of the seep near the mouth of the former ravine area. It appears most likely that these contaminants are from MGP wastes historically placed in the ravine.

A potential additional source of contamination on the Ashland Lakefront Property is the material comprising the "Coal Tar Dump" depicted on a 1953 site drawing prepared by Greeley and Hanson. Whether the material located in this area is in fact coal tar, wood treatment residuals, or some combination of these wastes has not been determined. The potential also exists that wood treatment may have historically occurred at other locations on the Ashland Lakefront Property. However, conclusive evidence of this has not been found to-date.

The sediment contamination appears to be chemically and physically similar to the contaminants at the Ashland Lakefront Property and in the former ravine area. The source(s) of offshore organic contaminants are almost certainly one or more of the same source(s) as identified at the

Ashland Lakefront Property. The mode of contaminant transport to the sediments was likely through subsurface seeps, historic surface water runoff, or possible discharge of contaminants from one or more of the aforementioned source areas through the historic open sewer. The offshore distribution of sediment contamination may be caused by various physical forces, including offshore and littoral currents, longshore drift, and sediment resuspension and settlement during periods of high energy.

2.9 Risk Assessment

Baseline risk assessments were performed to evaluate the likelihood that adverse human health or ecological effects are occurring or may occur as a result of exposures to the contamination identified in the soils, groundwater, or sediments.

2.9.1 Baseline Human Health Risk Assessment

SEH completed a baseline Human Health Risk Assessment (HHRA) of the Ashland Lakefront Property and adjacent nearshore sediments for the WDNR to evaluate the potential existing and future adverse health effects caused by hazardous substance releases from the site in the absence of any actions to control or mitigate the releases. The HHRA was limited to the filled lakefront property, adjacent nearshore sediments, and consider only the upper shallow groundwater table, site soils and nearshore sediments and lake water. The HHRA did not include evaluation of contaminated located in the former ravine or lower Copper Falls groundwater aquifer.

2.9.1.1 Potentially Exposed Populations and Scenarios

The populations identified as potentially at risk to experiencing adverse health effects as a result of contamination encountered at the Ashland Lakefront Property include occupational city workers and recreational adults, children and adolescents. In addition, adolescent trespassers to posted restricted areas of the site have been identified as a potential adolescent subpopulation at risk.

Potential current and future exposure pathways may be completed by the following routes.

Population	**Current Scenario**	**Future Scenario**
City Worker	Groundwater and seep water ingestion, inhalation, dermal absorption	Groundwater and seep water ingestion, inhalation, dermal absorption
	Subsoils ingestion, inhalation, dermal absorption in trench and seep area	
	Surface soils ingestion, inhalation, dermal absorption on site and seep area	Surface soils ingestion, inhalation, dermal absorption on site and seep area
Recreational adult, child, adolescent	Seep water ingestion, inhalation, dermal absorption	Groundwater inhalation; Seep water ingestion, inhalation, dermal absorption
	Surface soils ingestion, inhalation and dermal absorption on site in general; surface soils inhalation in seep area	Surface soils ingestion, inhalation and dermal absorption on site in general; surface soils inhalation in seep area
	Dermal absorption from water and sediments while swimming, boating, fishing; ingestion of fish tissue	Dermal absorption from water and sediments while swimming, boating, fishing; ingestion of fish tissue
Adolescent trespasser to seep area (in addition to the recreational risks)	Seep water ingestion, inhalation and dermal absorption	Seep water ingestion, inhalation and dermal absorption
	Surface soils at the seep area ingestion, inhalation, dermal absorption	Surface soils at the seep area ingestion, inhalation, dermal absorption

2.9.1.2 Exposure and Toxicity Assessment

Chemical specific intakes were calculated utilizing equations obtained either from USEPA guidance documents or ASTM guidance. Input variables for these formulas were either site specific data or developed in consultation with the Wisconsin Department of Health and Family Services (DHFS). The sources of toxicity information utilized in the intake equations are primarily from IRIS or HEAST (USEPA documents).

2.9.1.3 Risk Characterization Summary – Populations

Cumulative risk defined in ch. NR 720 Wisconsin Administrative Code specifies that the excess cancer risk may not exceed 1×10^{-5} the non-carcinogenic hazard index may not exceed one. The following table presents a summary of predicted risk for the potential exposure pathways described above. The tabulation of risk for both reasonable maximum exposure (RME) and mean (central tendency exposure - CTE) concentrations in current as well as future scenarios is also presented.

Population		Carcinogenic Risk		Non-carcinogenic Hazard Quotient	
		RME	CTE	RME	CTE
City Worker	current	8×10^{-2}	6×10^{-3}	2.1	0.21
	future	9×10^{-2}	6×10^{-3}	2.5	0.18
Recreational adult	current	2×10^{-2}	9×10^{-4}	6×10^{-1}	0.067
	future	2×10^{-2}	9×10^{-4}	2.2	0.18
Recreational child	current	3×10^{-2}	9×10^{-4}	3.7	0.18
	future	7×10^{-2}	2×10^{-3}	160	53
Recreational adolescent	current	4×10^{-2}	1×10^{-3}	2.4	0.082
	future	6×10^{-2}	1×10^{-3}	41	1.3
Trespassing adolescent	current	4×10^{-2}	2×10^{-3}	3.2	0.64
	future	4×10^{-2}	2×10^{-3}	3.2	0.16

2.9.1.4 Risk Characterization Summary – Subunits

The site was divided into four subunits in order to group the data and more accurately assess the contaminants to which various populations may be exposed. These subunits are: the current potential utility trench, the site in general, the seep area and the near shore area. RME risk associated with specific scenarios in excess of the Wisconsin Administrative Code standards at the subunits are as follows:

Current Utility Trench	- carcinogenic risk to City workers through dermal contact with groundwater (2×10^{-3})
Site in General	-future carcinogenic risk to City workers through dermal contact with groundwater (9×10^{-3}) -future carcinogenic risk to Recreational child and adolescent through dermal contact with surface soils (2×10^{-2} to 5×10^{-2}) -future non-carcinogenic risk to Recreational child through dermal contact with groundwater (144).
Seep Area	-current and future carcinogenic and non-carcinogenic risk to all exposed populations through dermal contact to seep water (2×10^{-2} to 7×10^{-2}; 2.8). -current carcinogenic risk to City workers through ingestion and dermal contact to subsurface soils (2×10^{-5}) -current and future carcinogenic risk to Trespassing adolescents through dermal contact with the surface soils (2×10^{-4}).
Near Shore	-current and future carcinogenic risk to all populations through dermal contact with sediments (2×10^{-5} to 3×10^{-5}).

2.9.1.5 Risk Uncertainty and Discussion

The risk measures utilized in a HHRA are not fully probabilitistic, but conditional estimates based on many assumptions about exposure and toxicity. Areas of uncertainty for the risk assessment generally include: environmental sampling and analyses, exposure point concentrations, toxicological information and exposure intake parameter selection.

Because of the conservative nature of many of the risk assessment assumptions, calculated risk is generally thought to result in an overestimation of risk. However, site specific uncertainties may well underestimate the risk at this site.

Major uncertainties associated with the Ashland Lakefront Property HHRA are the lack of information regarding the immiscible tar-like organic contaminant fraction at the site. Laboratory samples may not be truly representative of the concentration of the tar-like material identified at the site. Also, a general lack of understanding of the concentration of this fraction as well as physical characteristics of the material adds to risk uncertainty. In addition, since coal tar is a mixture reported to contain over 300 compounds which are rarely consistent in type and concentration, methods which use individual chemical properties, as is used on this assessment, to calculate the site risks may not be accurate in predicting risk from exposure to the mixture.

2.9.2 Baseline Ecological Risk Assessment

SEH completed an Ecological Risk Assessment (ERA) of the contaminated sediments adjacent to the Ashland Lakefront Property (SEH, October 1998). The purpose of the ERA was to evaluate the likelihood that adverse ecological effects are occurring or may occur as a result of exposure to contaminants previously identified in near shore sediments located immediately adjacent to the Ashland Lakefront Property.

Based on review of relevant literature and the results of the exposure/response analyses conducted for the ERA, strong evidence exists that the current and future ecological risks are high associated with the contaminated sediments adjacent to the Ashland Lakefront Property.

2.9.2.1 Ecological Risk Assessment – Study Design

A weight-of-evidence approach was utilized to assess the potential existing and future ecological risks associated with the contaminated sediments to the benthic, aquatic, and terrestrial communities. Weight of evidence was accumulated by several means including: 1) a literature search conducted to select relevant sediment effects benchmarks for evaluation of site data and identify ecological effects documented at other sites with similar contaminants and exposures; 2) sediment samples collected, analyzed, and compared to sediment effects benchmarks for the contaminants identified; 3) a survey conducted of the benthic community at contaminated and reference locations; and 4) a series of laboratory toxicity tests conducted to characterize the effects of short term exposure to the contaminated and reference sediment samples.

2.9.2.2 Chemical Data Evaluation

Chemical data was converted to toxic units to evaluate the cumulative effects of different chemicals in the contaminant mixture existing in the sediments. Chemical data, sediment survey results, and toxicity study results were integrated to assess the level of ecological risk associated with varying exposure levels at the site. The results of sediment elutriate dilutions were used to strengthen the exposure response characterization, and extrapolated to evaluate the potential effects across the contaminated sediment area with respect to the larger database of PAH and VOC concentrations.

Several sets of sediment effects benchmarks were identified in the literature search. Sediment chemical data was compared to several sets of probable effects levels for both dry weight units and normalized-to-organic-carbon (NOC) units. PAH and VOC benchmarks were exceeded for several chemicals at several locations in the shallow bioactive zone sediments and deeper sediments. Based on this comparison, it was concluded there was a high probability of adverse effects to aquatic life and human health from the contaminated sediments.

Additionally, a water column sample collected during a 3 foot wave period exhibited PAH concentrations which exceeded secondary acute and chronic water quality criteria values.

Comparison of the site PAH concentrations to data in the literature from other sites indicated that PAHs may be accumulating in resident fish species, especially bottom feeders. Exposure of fish to the mutagenic PAH contaminants may result in fish tumors, impaired health, and ultimately, death.

The sediment effects concentration benchmarks developed by Ingersoll, et al, for the USEPA in 1996 were retained to compare relative toxicity of the PAH mixtures. Specifically the probable effects values calculated using effects range median values developed from 28 day sediment toxicity tests on *Hyallela azteca* (HA -28 ERM) were utilized to represent chemical specific toxic units. Dry weight and NOC toxic units were calculated by dividing the site chemical data by the HA-28 ERMs.

2.9.2.3 Benthic Community Evaluation

Benthic community surveys were conducted at two contaminated stations and two reference stations. Benthic community survey results were evaluated for richness, abundance and relative indices. Graphical analyses indicated that the community degradation strongly correlates to the sum of dry weight toxic units for most of the indices.

2.9.2.4 Toxicity Study Evaluation

Toxicity studies were conducted on several species sediment samples collected from the same two contaminated stations and reference stations. Whole sediment toxicity tests were conducted on the following benthic species: *Hyallela azteca* (amphipod), *Lumbriculus variegatus* (aquatic worm-oligochaete), and *Chironomus tentans* (midge larvae). Elutriate toxicity tests were conducted on *Daphia magna* (zooplankton) and *Pimephales promeles* (fathead minnow larvae). Toxicity test results were evaluated for effects on survival and growth, and graphically compared to NOC toxic units. Statistically significant differences in survival and/or growth were documented between each sample. Toxic effects appeared to correlate well to toxic units. Elutriate dilution toxicity test results supported the toxic units exposure/effects characterization.

Results of literature search indicated that the toxic effects of certain PAHs may be enhanced by exposure to UV sunlight. Comparison of phototoxic PAH concentrations at the site to reference levels in the literature indicated it was likely a phototoxic effect could be present at the site. Phototoxicity studies were performed in conjunction with standard toxicity tests organisms exposed to sediment samples collected from the site. Evidence of enhanced phototoxicity effects were shown for benthic organisms, zooplankton, and fish larvae. Graphical representation of the data indicated that the toxic effects were directly related to the total concentrations of the phototoxic PAHs.

2.9.2.5 Ecological Risk Characterization

The weight of evidence indicates that a strong potential exists for ecological risks to be high associated with the contaminated sediments in the bioactive zone. The weight of evidence includes: 1) exceedances of several independent sediment effects benchmarks; 2) evidence of benthic community impairment in the contaminated areas; 3) results of standard and photo-enhanced toxicity tests that indicate ecological effects increase with increased exposure; 4) exceedance of acute and chronic water quality criteria during heavy wave action; and 5) sediment concentrations of PAHs similar to those at other sites where bioaccumulation and mutagenic effects have been observed.

The sum of toxic units in the deeper sediments appears to be significantly higher than in the surficial bioactive zone. Future disturbance and exposure of the deeper contaminated sediments to the water column by either natural (storms, ice scouring) or uncontrolled anthropogenic (boat prop wash, shoreline maintenance) forces could potentially result in severe acute ecological effects in and possibly beyond the localized contaminated sediment area.

Ecological impacts to the benthic community may include acute and chronic toxic effects from direct contact with and ingestion of impacted sediments and water. Impacts to the fish community could include acute and chronic effects from ingesting contaminated food, or direct contact with contaminated sediments and water. Immature fish and spawn are expected to be especially susceptible to acute effects based on the results of the photo enhanced toxicity studies. Another potential impact to the fish community is the loss of the lower level benthic community food source in the contaminated area. Likewise the terrestrial community may suffer from exposure to the contaminated water and sediments, ingestion of contaminated food, or loss of food source.

3.0 Remedial Action Objectives

3.1 Remedial Action Objectives

Remedial action objectives are identified in order to guide the development of site specific remedial actions. The remedial action objectives are broadly stated to allow progressive narrowing of the remediation scope. Activities and technologies which satisfy the remedial action objectives will eliminate or reduce human health and environmental risks posed by exposure to the contaminants at the site. Considering the general goals of protecting public health and the environment, the following specific remedial action objectives have been developed. It is likely that some of the objectives may be modified once final delineation of the contamination is complete and remedial objectives for contiguous sites have been developed.

- Minimize potential risk to human health and the environment from exposure to contaminants.
- Limit future offsite migration of contaminants
- Limit future onsite migration of contaminants from up gradient and lateral contiguous properties.
- Implement remedial action that will accommodate future development and beneficial public use of the site.
- Implement remedial action that will be compatible with future activities at contiguous properties and not directly nor indirectly cause deterioration of contiguous properties.

3.2 Cleanup Goals

Chemical specific standards for soil and groundwater are defined in ch. NR 720 and ch. NR 140 as protective of human health and the environment. For the purposes of this FS, it will be assumed that ch. NR 140 ES and ch. NR 720 RCLs will be the cleanup goals for groundwater and soil, respectively. Figure 3 indicates the approximate limits within which soils and/or groundwater contamination exceeds the standards. Site specific cleanup goals may be established once a remedial option is selected.

No chemical specific standards have yet been promulgated for sediment quality. The USEPA is currently cooperating with Environment Canada to develop sediment quality guidelines for the Great Lakes. Pending the promulgation of regulatory cleanup standards, this FS will assume the toxicity units approach developed in the ERA (SEH, October 1998) will be utilized to develop cleanup goals. Review of the ecological response to sediment PAH levels based on the ERA studies indicates significant impacts occur at exposure between 7 and 15 HA-28 NOC toxicity units. Given a number of considerations, the initial cleanup goal for the contaminated sediment area will be established at 10 HA-28 NOC toxicity units. The calculation of toxicity units for a sample will depend on the concentrations of specific PAHs. Generally, 10 HA-28 NOC toxicity units correlates to a total PAH concentration between 2500 to 3000 μg/kg on a dry weight basis and 80 μg/g TOC on a total organic carbon normalized basis (assuming average 3.5%TOC). Most of the area within the approximate limits of sediment contamination exceeds the 10 HA-28 toxicity unit value at depths to 10 feet into the sediment. Site specific cleanup goals may be established once a remedial option is selected.

3.3 Remediation Action Boundaries

This FS is directed at remediating the areas in the park and offshore within the approximate limits of contamination delineated on Figure 3. The vertical limit of the remedial action will be limited to contamination identified in soils, groundwater and sediments which exist above the underlying Miller Creek aquitard.

Under a separate effort, NSP is currently considering options to address the related MGP contamination identified up gradient of the park area and in the lower aquifer.

The extent of subsurface contamination has not yet been clearly delineated to the east of Prentice Avenue in Kreher RV Park parking lot, and is not addressed by this FS.

3.4 Remediation Quantities

The contaminated park area covers approximately 10 acres, including the former WWTP building. In general across the site, a 1 to 2 foot layer of clean surficial soil overlies the contaminated fill which is comprised of soil mixed with slab wood and sawdust. The depth of contamination ranges from approximately 1 to 15 feet. Approximately 45,000 cubic yards of relatively clean fill overlies the impacted fill. The impacted fill occupies a volume of approximately 150,000 cubic yards, including approximately 49,000 cubic yards of wood waste. Waste quantity calculations are provided in Appendix B "Waste Quantity Calculations".

The contaminated sediment area covers approximately 9.5 acres to a depth of approximately 10 feet. The upper portion of the sediments is generally covered by a wood waste layer which is 9" thick on average but which ranges in thickness from 0 to 7 feet across the site. The volume of contaminated sediments is approximately 152,000 cubic yards, including approximately 4000 cubic yards of wood waste.

The volume of residual tar in the contaminated park area is estimated to range from 29,000 gallons to 71,000 gallons in the contaminated park area. The volume of residual tar in the contaminated sediment area is estimated to range from 17,000 gallons to 84,000 gallons. The total estimated range is between 46,000 to 155,000 gallons of tar. Only 40% of the tar is assumed to be directly recoverable by extraction processes (18,000 to 62,000 gallons). The calculation of the residual tar quantity is provided in Appendix B. The calculation does not include the residual tar up gradient or in the Copper Falls aquifer.

An estimate of the original volume of waste tar that might have been migrated across the park site and sediments was also calculated based upon the mass of benzo(a)pyrene present. Because benzo(a)pyrene is not readily biodegraded, solubilized or volatilized, its mass is likely to be similar to its mass when originally deposited. As shown in the calculations in Appendix B, approximately 3,100 lbs of benzo(a)pyrene exist in the site soils, sediments, and groundwater. Benzo(a)pyrene is reported to represent 0.1% to 0.3% of MGP tars. Applying these ratios, indicates that between 136,000 and 394,000 gallons of tar wastes may have been discharged to the site. This volume appears reasonable when compared to the estimate of residual tar.

4.0 Applicable Regulations

A brief summary of the applicable or relevant and appropriate requirements (ARARs) that may apply to remediation activities at the site is included in this section. The summary includes descriptions of chemical-specific requirements, location-specific, and action-specific requirements for the proposed remediations options. Applicable regulations are included in Table 2, "Review of Potential Chemical-Specific and Action-Specific Applicable or Relevant and Appropriate Requirements (ARARs) and Information To Be Considered (TBC)," and Table 3, "Review of Potential Location-Specific and Action Specific ARARs and TBCs."

4.1 Chemical-Specific Requirements

Chemical-specific ARARs are requirements that regulate the release or presence of specific chemical constituents in the environment. These requirements generally establish risk-based concentration levels or discharge limits for specific chemicals. The concentration levels generally are determined based on human health risks.

In Wisconsin, target cleanup levels for specific chemicals in groundwater and soil are established in ch. NR 140 and ch. NR 720, respectively. For instance, groundwater cleanup standards are listed as Enforcement Standards (ESS) in ch. NR 140. Generic residual cleanup levels (RCLs) for specific chemicals are listed in ch. NR 720. If the ES or RCL for specific chemicals are not relevant or appropriate to the site or published values are not available for specific chemicals, RCLs may need to be calculated for contaminants in an effort to protect public health, safety and welfare, and the environment. Additional chemical-specific ARARs (both State and Federal) that may apply during potential remediation of the soil, sediment, and groundwater at the site are included in Table 2.

Chemical specific cleanup levels may also be required for remediation residuals, including off-gases and water. Off-gases will be required to meet air emissions requirements listed in ch. NR 400. Federal Clean Air Act regulations may also apply to air emissions from remediation activities at the site.

Water treatment levels will be based on the point of discharge. Discharges to the sanitary sewer will be required to meet the requirements of the City of Ashland. Discharges to the storm system or Chequamegon Bay will require a WPDES permit from the WDNR. Currently the Great Lakes Initiative (GLI) is recommending that discharges to Lake Superior contain zero contaminants. The Federal Clean Water Act may also have specific requirements.

Due to the presence of NAPL at some locations onsite, contaminated materials potentially could be classified as characteristic hazardous waste in general accordance with the Resource Conservation and Recovery Act (RCRA) and the Toxic Substances Control Act (TSCA) under certain conditions. To date, analyses of onsite soils have not indicated leachable contaminant concentrations characteristic of a hazardous waste.

4.2 Location-Specific Requirements

Location-specific ARARs are requirements that relate to the geographic location or features of the site. These requirements may affect the remedial action choices or may impose constraints on specific remedial alternatives.

Chequamegon Bay is a navigable waterway. Any construction activities undertaken in the bay will require review and a permit from the U.S. Army Corps of Engineers under the Rivers and Harbors Act of 1899.

The site may be considered a filled lakebed and be subject to laws pertaining to waters of the State of Wisconsin and regulations pertaining to the Coastal Zone Management Act. The GLI may also have significant criteria potentially regulating remedial actions at the site.

The site is located in the immediate vicinity of a residential neighborhood. Local ordinances may dictate maximum working noise levels, hours of operation, and traffic patterns. Local building or grading permits may be required for excavation work. Certain hazardous waste handling activities may be prohibited.

A railroad is located adjacent to the site. Construction activities conducted within the railroad right-of-way also be subject to specific requirements of the railroad. Specific ARARs that may apply to the site due to its location are included in Table 3.

4.3 Action-Specific Requirements

Specific remedial activities selected to accomplish site cleanup are regulated or controlled by action-specific ARARs. Action-specific requirements regulate how a selected alternative must be accomplished. Example action-specific ARARs are discussed herein as they may pertain to possible remedial alternatives.

The Federal Occupation Safety and Health Act (OSHA) includes several regulations regarding remediation, excavation, and construction activities; general facility requirements related to handling hazardous wastes; and regulations related to transportation of solid and hazardous wastes over public highways.

Any sediment remediation project conducted with Federal funds would require compliance with the National Environmental Policy Act (NEPA) which may require an environmental impact statement (EIS).

Several State of Wisconsin Administrative Code regulations may apply to specific actions potentially implemented at this site, particularly those enforced by the WDNR and the Department of Commerce (DCOM). These regulations include, but are not limited to, the ch. NR 100 series on water quality, the ch. NR 200 series on the Wisconsin Pollution Discharge Elimination System, the ch. NR 400 series on air quality, the ch. NR 500 series for solid waste handling, the ch. NR 600 series on hazardous waste management, the ch. NR 700 series on environmental remediation, and DCOM building safety requirements.

5.0 Identification and Screening of Potential Remedial Technologies

General response actions that satisfy the remedial action objectives are identified and described. Table 4 "General Response Actions - Technology Screening presents a list of technologies under each general response action and documents the preliminary screening.

5.1 General Response Actions

General response actions are broad categories of activities and technologies that may be applied alone or in combination in order to accomplish the remedial action objectives. The general response actions may be applicable to one or more media at the site. Some general response actions are required only in combination with other general response actions. Therefore, not all remediation alternatives will include all of the identified general response actions. Specific activities and technologies within each general response action category are identified for evaluation and assembly into potential remedial actions. The general response actions for the Ashland Lakefront Property are:

- Institutional Controls
- Access Restrictions
- Engineering Controls – Landside
- Engineering Controls – Offshore
- In Situ Treatment
- Excavation – Landside
- Sediment Dredging
- Physical Separation
- Solids Dewatering
- Transportation
- Ex Situ Solids Treatment
- Ex Situ Process Incorporation/Co-treatment
- Disposal
- Water Treatment
- Water Disposal
- Off-gas Treatment

5.1.1 Institutional Controls

Institutional controls include legal restrictions and ordinances to prevent site disturbance, restrict site usage, and discourage trespassing.

5.1.2 Access Restrictions

Access restrictions include physical restrictions to limit access to the site by unauthorized personnel, and may include posted warnings, security fences, security personnel, and video surveillance.

5.1.3 Engineering Controls – Landside

Engineering controls include technologies to prevent leaching or migration of contaminants. Control options include physical horizontal and vertical barriers, as well as hydraulic control systems to maintain a stable hydraulic head or inward gradient within the contaminated area.

5.1.4 Engineering Controls – Offshore

Offshore engineering controls include breakwaters or armoring to limit wave action disturbance of the sediments, surface caps to limit exposure to contaminants, and silt curtains to control migration of suspended solids.

5.1.5 In Situ Treatment

In situ treatment allows the contaminants to be treated in place to minimize site disturbances and logistical efforts associated with removal. A variety of in situ treatment technologies are available for contaminant destruction, extraction, or mobility reduction. Technologies include volatilization, thermally enhanced volatilization or mobilization, flushing, bioremediation, or stabilization.

5.1.6 Excavation – Landside

Excavation removes the contaminated materials from their current location for treatment or transport to disposal. Excavation is typically conducted by backhoes or other large machinery.

5.1.7 Sediment Dredging

Sediment dredging is utilized to remove the sediments from their current location for treatment or transport to disposal. Dredging methods include both hydraulic and mechanical approaches.

5.1.8 Physical Separation

Physical separation processes may be utilized to separate the various fractions of the excavated or dredged materials including wood waste, fines, and coarse sands.

5.1.9 Solids Dewatering

Most treatment technologies are limited in their ability to handle water in soils. For these technologies, it would be necessary to remove excess water from soils prior to treatment. Optimum moisture contents will vary depending on which treatment technologies or transport and disposal methods will be utilized.

5.1.10 Transportation

Transportation of excavated materials offsite to treatment or disposal areas may include a variety of methods including railcars, trucks, and barges.

5.1.11 Ex Situ Solids Treatment

A variety of ex situ treatment technologies are available for contaminant destruction, extraction, or mobility reduction including thermal oxidation, stabilization, bioreactors, and soil washing. Several other technologies are still in development and testing and have not been discussed here.

5.1.12 Ex Situ Process Incorporation/Co-treatment

Wastes may be incorporated into existing processes for beneficial use and co treatment. Processes include co-burning for fuel in utility boilers, asphalt blending, fuel blending, and brick manufacture.

5.1.13 Disposal

Excavated materials may be transported off site to engineered landfills or confined disposal facilities (sediments only). Materials may require pretreatment prior to disposal.

5.1.14 Water Treatment

Soils dewatering and/or treatment, and groundwater pumping hydraulic controls generate contaminated water that will require treatment. Selected treatment technologies would be required to meet applicable discharge requirements and be approved as best available technology.

5.1.15 Water Disposal

Treated water may potentially be discharged to the municipal sewer or to Chequamegon Bay via the storm sewer. Untreated water may be hauled offsite.

5.1.16 Off-Gas Treatment

Off-gases captured during removal and or treatment operations may require treatment prior to discharge to the atmosphere. Contaminants removed may include both organics and inorganic constituents. Off-gas treatment technologies that may be applied include carbon adsorption, thermal or catalytic oxidation, air scrubbing, condensation, and/or biofiltration.

5.2 Screening Criteria

While several of the technologies identified under each general response action may be applicable to the site remediation, only a limited number can be evaluated as part of a combined remedial action. Therefore the technologies in each general response action were screened in Table 4 to select those technologies to be retained for further evaluation. Some of the technologies not retained at this juncture may be re-evaluated during the value-engineering phase of a future design study, after a general approach to remediation has been selected

The screening criteria used are implementability and cost. These are described in more detail in the following paragraphs.

Implementability is an evaluation of the administrative and technical implementability of permitting, acquiring, and applying the technology to the site, such that it will be effective to meet one or more of the remediation objectives.

Cost screening is limited to a qualitative comparison of relative costs in order to eliminate technologies with comparably excessive costs. Both capital costs and operation and maintenance costs are considered.

6.0 Treatability Studies

Short term studies were conducted to determine the potential for bioremediation at the site, and to evaluate the sediment settling dynamics and associated contaminated distribution.

6.1 In Situ Bioremediation

Anaerobic and aerobic microbial assays and nutrient analyses were conducted for the purposes of evaluating the potential for natural or enhanced bioremediation of contaminants in the sediments. Results of the studies are presented in Table 5, "Summary of Microbial Enumeration Assay Results." Laboratory reports were provided as appendices to the Sediment Investigation Report (SEH, July 1996), and the Ecological Risk Assessment (SEH, October 1996). The locations of the samples collected for the anaerobic analysis are shown on Figure 4.

The results indicate that low total microbial populations and very low degrader populations are expected to be present in the contaminated sediments and that natural degradation is unlikely to occur at significant rates. Furthermore, the populations in the contaminated areas were less than what is considered to be amenable to enhanced in situ bioremediation.

Long chain high molecular weight PAHs such a Benzo(a)pyrene and Benz(a)anthracene are generally considered to be biorecalcitrant, and not expected to biodegrade in sediments without pretreatment with oxidizing agents to break bonds. Current research is being conducted to explore the in situ anaerobic biodegradation of long chain PAHs beneath sediment caps.

6.2 Sediment Settling and Contaminant Dispersion

A sediment settling test was conducted in general accordance with the US Army Corps of Engineers testing protocol to evaluate the settling properties of the sediment if dredged. Chemical analyses of the sediment and water column was conducted during the test to define the contaminant dispersion effects.

A composite sediment samples was collected from 3 locations in the offshore sediments, shown on Figure 4. 10 gallons of sediments were initially mixed in a drum with water from the lake, so that the coarse sands could fall out. The finer sediments remained in suspension and were pumped to 6 feet settling column, and allowed to settle for approximately 15 days. Water samples were collected from the column at spaced time intervals and analyzed for total solids content to evaluate the settling rate. Once the test was complete, a polymer was mixed into the column to promote flocculation and enhance the settling process.

Samples were collected from the initial composite sediment, the separated coarse sand, the initial slurry mix, the water column, and final settled fines (after flocculation). The samples were analyzed for PAHs and VOCs.

As shown on Table 6 "Summary of Contaminant Dispersion/Sediment Settling Study Results," suspended solids remained high in the water column even after 11 days of settling. Addition of polymer was required to enhance the settlement of the suspended fines. This indicates gravity settling would not suffice and that mechanical separation of the fines from dredge water would be required.

The contaminant concentration was an order of magnitude higher in the settled fine slurry than in the coarse sands. However, the contaminant concentration in the coarse sands were still high enough to require treatment or controlled disposal.

Water samples collected from the column test indicate that the contaminant concentrations in the water column would exceed the National Ambient Water Quality Criteria acute and chronic values. Therefore, sediment dredging operations would require engineering controls to prevent the release of contaminants to the lake beyond the remediation area. The accedence in the clear water (after the enhanced flocculation settling) indicates that a silt curtain would not be sufficient.

Further details of the study are currently being documented and will be released as a separate report.

7.0 Remedial Action Options

This section presents and evaluates the "no further action" option and eight remedial action options potentially feasible to meet the remedial action objectives. The options presented include various orders of complexity, site disturbance, and economic impact. Each option has been illustrated in the separately bound figures which accompany this report. SEH recommends that the option descriptions are reviewed concurrently with the figures.

- **Option A1** – No Further Action
- **Option B1** – Access Restrictions and Institutional Controls
- **Option C1** – Engineering Controls/Confinement/Thick Sediment Cap/Extend Shoreline to 2900N
- **Option C2** – Engineering Controls/ Confinement/ Armored Sediment Cap
- **Option D1** – Engineering Controls/Confinement/Thick Sediment Cap/In Situ Remediation/Extend Shoreline to 2900N
- **Option D2** – Engineering Controls/Confinement/Nearshore Confined Treatment Facility for Sediments/In Situ Remediation/Extend Shoreline to 2500N
- **Option E1** – Engineering Controls/Confinement/Removal with Ex Situ Treatment and Backfill
- **Option E2** – Engineering Controls/Confinement/Removal and Ex Situ Disposal/New Backfill
- **Option E3** – Engineering Controls/ Confinement/Removal and Ex Situ Disposal/No Backfill

This section presents a summary of various assumptions necessary to create the options and then provides a description of each option.

7.1 Assumptions

A variety of assumptions were necessary to develop the different remedial action options and associated cost estimates. The validity of the assumptions, whether technical, regulatory, or community acceptance issues, will require further analysis before the WDNR finalizes the selection of an option. Several of these assumptions are discussed below.

7.1.1 Technical Assumptions

Technical assumptions relate to the selection of technologies included in each option. A representative list of assumptions follows:

- The city streets and/or railroad will be available for transportation of waste materials and/or new backfill.

- The railroad may be temporarily inactive.
- The NSP Bay Front facility would be willing to accept the wood waste as a potential fuel source.
- Contamination may remain up gradient for several years, and controls will be necessary to cut off future migration onto the site.
- NSP will be actively remediating the up gradient contamination
- Air emissions control systems will be required to prevent windborne exposure to the community from volatilizing chemicals. Air monitoring alone will not suffice.
- Workers will utilize appropriate personal protective equipment to minimize the potential for exposures to contaminants.
- The former WWTP building will be available to house treatment equipment.
- The existing marina parking will be relocated temporarily or permanently.
- Short term capacity exists in the sanitary sewer system and at the WWTP up to 100 gallons per minute, except during occasional peak flow periods.
- Long term capacity exists in the sanitary sewer system and at the WWTP up to 20 gallons per minute.
- During dredging, a variance will be allowed for temporary discharge of treated waters at effluent concentrations higher than the current regulatory limits

7.1.2 Regulatory Assumptions

Many of the options selected would require variances to existing permits or regulations. Additionally, existing regulations may change prior to the implementation of the chosen remedy. A representative list of assumptions follows:

- The city, county, state, tribal, or federal agencies will not prohibit the actions outlined by the passage of new laws or ordinances, and/or will not formally act to prevent associated variances.
- The NSP Bay Front Facility will be able to expand its current air permit to include the wood waste materials from the site.
- NSP will accept the wood waste for fuel if the option is selected
- The waste materials are not considered hazardous (based on the TCP analysis) and therefore regulations concerning hazardous wastes will not apply.
- Variances will be granted to backfill excavated areas in the existing filled-lake areas (Kreher Park), or to fill in the current contaminated sediment area. Both of these areas are considered waters of the state.

- Permits would be approved for a breakwater, sediment capping, sediment armoring, dredging, and/or construction of a near shore confined treatment facility.
- Permits would be granted for discharge of the treated dredge water back to Lake Superior
- Permits and variance applications will be given priority by approving agencies and take less than a year to process.
- Application of future sediment clean-up standards will not significantly change the areas or volumes of sediments requiring remediation.
- Future sediment clean-up standards will allow in situ capping and/or treatment.
- The remedy will be administered under ch. NR 700 regulations. The remedy will not be administered by the EPA or according to the requirements of CERCLA.

7.1.3 Community Acceptance Assumptions

The site is located in an active community area on Lake Superior. The community as defined here includes the local residents and businesses as well as local tribal and public interest groups. Community acceptance will play a major role in the selection and successful implementation of the remedy. Broad assumptions are listed below:

- The community will not object to any of the options or associated disruptions, provided that risk issues are addressed properly and work is conducted within normal constraints (work hours, safety issues, noise and odor controls, etc.)
- The transfer and final placement of the waste into licensed landfills in other areas may be acceptable to those local communities.

7.2 Evaluation Criteria

Remedial action options are evaluated according to the technical and economic feasibility criteria outlined in s. NR 722.07(4).

The technical feasibility of an option is evaluated according to the following criteria:

- Long-term effectiveness
- Short-term effectiveness
- Implementability
- Restoration Time Frame

The economic feasibility of an option is evaluated according to the following criteria:

- Costs
- Potential Future Liability

Each of the criteria are further described below.

7.2.1 Long Term Effectiveness

Long term effectiveness includes the degree to which the toxicity, mobility and volume of the contamination is reduced as well as an assessment of long term human health and ecological impacts, after the remedy is complete.

Long term human health impacts are those associated with the residual contamination after the remedy is complete, as well as risks associated with the final disposition of relocated wastes. Long term ecological risks include those risks associated with residual contamination, as well as final disposition of any relocated wastes after the remedy is considered complete.

7.2.2 Short Term Effectiveness

Short term effectiveness includes an assessment of potential short term human health and ecological impacts, during implementation of the remedy.

Short term human health impacts include risks to the community, as well as to workers involved in the remediation during the implementation of the remedy.

Short term ecological impacts may include risks to the local environment during implementation of the remedy, as well as potential risks to other environments during the offsite transport, treatment, or disposal of wastes.

7.2.3 Implementability

Implementability takes into account several factors including:

- Constructability
- Availability of services and materials
- Reliability of Technology
- Monitoring Considerations
- Ease of undertaking additional remedial action
- Compliance with ARARs
- Administrative Requirements

- Community Acceptance
- Presence of Threatened or Endangered Species

7.2.4 Restoration Time Frame

The expected time frame needed to achieve the remedy includes evaluation of:

- Proximity of contamination to receptors
- Sensitive or endangered species or ecosystem
- Current use of the site resources
- Magnitude, mobility, and toxicity of the contamination
- Geologic and hydrogeologic conditions
- Effectiveness, reliability, and enforceability of institutional controls
- Naturally occurring biodegradation processes at the site

7.2.5 Costs

Cost analysis of an option includes the following:

- Initial capital costs
- Annual operations, maintenance, and monitoring (OMM) costs
- Present worth total costs (including 40 years long-term OMM costs calculated to present worth)
- Annualized total costs (with initial capital costs amortized over 40 years)

In accordance with ch. NR 722, capitalized and amortized costs were calculated for a 40 year period.

The costs analysis does not consider other less tangible factors which might be associated with either leaving the contamination unabated or with the remedial action disturbances. These factors may include impacts to tourism, future development, real estate valuation, indirect health care, or natural resource degradation.

7.2.6 Potential Future Liability

A qualitative evaluation regarding the potential for high costs associated with future liability, after the remedy is complete. This is based on the effectiveness and reliability of the remedy.

7.3 Option A1 – No Further Action

7.3.1 Description

This option would include no further action beyond the steps taken to date (fence around seep, posted warning signs, warning buoys).

7.3.2 Long Term Effectiveness – Option A1

There would be no significant reduction in the toxicity, mobility, or volume of the contamination. Long term human health and ecological risks would remain high, as described in the HHRA (SEH, June 1998) and ERA (SEH, October 1998).

7.3.3 Short Term Effectiveness – Option A1

Short term human health and ecological risks would remain high, as described in the HHRA and ERA.

7.3.4 Implementability – Option A1

This option would not likely be implementable because it would not comply with ch. NR 140, ch. NR 720, or pending sediment cleanup requirements. It is also unlikely that stakeholders of the community would find the "no further action" alternative acceptable given the risks to human health and the environment.

There are no significant concerns regarding constructability, availability, reliability, monitoring, or ease of undertaking additional remedial action. There are no known endangered or threatened species present.

7.3.5 Restoration Time Frame – Option A1

This option is not expected to restore the site within 100 years. Large volumes of contamination are present, and will continue to migrate in the shallow groundwater through the permeable sand and wood waste to Lake Superior and the underlying sediments. Biological enumeration studies indicate that existing microbial degrader populations are very low and will not have a significant effect on reducing the contaminant mass. The long chain PAHs are not considered to be readily naturally biodegraded even under ideal conditions, which do not exist at this site.

7.3.6 Costs – Option A1

Costs for option A1 are presumed to be $0, as the option requires no further action.

7.3.7 Potential Future Liability – Option A1

This option is considered to have very high relative liability, because the contaminants would not be reduced nor contained. Realization of the human health and ecological risks could result in high future costs.

7.4 Option B1 – Access Restrictions and Institutional Controls

7.4.1 Description

Option B1 would be directed at reducing current and future exposure to currently accessible contaminated media. Figure 5, "Option B1 – Access/ Institutional Controls" illustrates this option. A fence would be installed along the shoreline, and a larger fence would be installed around the seep area to prevent direct human access (except trespassers). Existing utilities would be routed around the site to minimize the need for future subsurface disturbance in the contaminated areas.

The 3rd Avenue storm sewer which discharges above the railroad tracks would be extended parallel to the railroad tracks to connect into an existing storm sewer along Prentice Avenue. This action would be expected to minimize the source of water in the seep area.

A breakwater would be constructed along the 2900N grid line to prevent access from boats and fish, and to minimize the potential for future disturbance of the deeper more contaminated sediments. A fence would be installed along the breakwater to prevent intrusion into the contaminated sediment area.

Posted warnings and legal restrictions would be required to encourage use of safety equipment for any potential subsurface disturbance. Deed restrictions would be implemented to prevent the installation of future subsurface utilities or foundations. Long term monitoring of perimeter wells would be required to assess the potential for further migration.

The offshore area inside the breakwater could potentially be used as a CDF for future dredging activities in Chequamegon Bay.

7.4.2 Long Term Effectiveness – Option B1

This option would have no effect on the reduction of the toxicity, mobility or volume of the contamination. With the exception of trespassers, long term human health impacts would be reduced as long as the access restrictions and institutional controls were maintained. Long term ecological risks to the fish would be reduced as long as the contamination did not migrate beneath the breakwater. Ecological risks would still exist for the benthic community and birds.

7.4.3 Short Term Effectiveness – Option B1

With the exception of trespassers, short term human health risks would be reduced. Ecological risks would be reduced for fish because the breakwater would prevent access, but not the benthic community or birds.

7.4.4 Implementability – Option B1

This option would not likely be implementable because it would not comply with ch. NR 140, ch. NR 720, or pending sediment cleanup requirements. Community acceptance of this option is unlikely due to the associated fencing and warning signs that would be required in the heart of the community park area.

There are no significant concerns regarding constructability, availability, reliability, monitoring, or ease of undertaking additional remedial action. There are no known endangered or threatened species present.

7.4.5 Restoration Time Frame – Option B1

This option is not expected to restore the site within 100 years. Large volumes of contamination are present, and will continue to migrate in the shallow groundwater through the permeable sand and wood waste to Lake Superior and the underlying sediments. Biological enumeration studies indicate that existing microbial degrader populations are very low and will not have a significant effect on reducing the contaminant mass. The long chain PAHs are not considered to be readily naturally biodegraded even under ideal conditions, which do not exist at this site.

7.4.6 Costs – Option B1

The preliminary projection of total initial capital costs for this option is approximately $4,000,000. The projection includes costs for design data collection, and remedial action implementation. A detailed breakdown of the cost projection calculation is provided in Appendix C.

Annual operations, maintenance, and monitoring (OMM) costs are projected to be approximately $31,000 per year. OMM costs include quarterly monitoring, and maintenance of the fence and breakwater.

Capitalized total cost over a 40 year period for this option are projected to be approximately $4,300,000. OMM costs were converted to present worth at a net interest rate of 5%.

Annualized total costs were calculated to be approximately $250,000, assuming that the initial capital costs are amortized over 40 years at an interest rate of 5%.

7.4.7 Potential Future Liability – Option B1

This option is considered to have very high relative liability, because the contaminants would not be reduced nor contained. Realization of the human health and ecological risks could result in high future costs.

7.5 Option C1 – Engineering Controls/Confinement/Thick Sediment Cap/Extend Shoreline to 2900N

7.5.1 Description

Option C1 would be directed at reducing current and future exposures, minimizing the potential for future migration, and minimizing the potential for disturbance from anthropogenic or natural events. This option would include many of the items (utility rerouting, new breakwater along 2900N, warning signs, institutional restrictions) discussed in Option B1 to immediately reduce risks as well as some additional engineering controls. Figure 6, "Option C1 – Engineering Controls/Thick Sediment Cap" illustrates this option.

An impermeable subsurface cutoff wall would be installed around the perimeter of the contaminated area to confine the contamination and prevent further migration. The perimeter confinement wall would be keyed into the underlying Miller Creek aquitard.

The impermeable cutoff wall would be installed through the 2900N breakwater. Alternately, during breakwater construction, parallel sheetpiles could be driven into the underlying aquitard. Bentonite could be mixed into the sediments and fill between the parallel sheetpiles, such that the breakwater itself could serve as the impermeable cutoff wall.

Low flow pumping would be conducted within the confined area to maintain an internal gradient. A gravel trench hydraulic cutoff wall would be installed between the railroad and the exterior of the up gradient perimeter wall. The cutoff trench would capture contaminants migrating from up gradient and prevent the contamination of areas lateral to the confined area. Water from the cutoff trench and internal gradient control system would treated and discharged to the sanitary system.

After the new breakwater and perimeter cutoff walls would be installed, offshore pilings would be cut off and removed, the rip-rap would be removed from the current shoreline, and the park would be cleared and grubbed. The entire area (except the WWTP) would be covered with one foot of clean sand followed by an impermeable synthetic geomembrane barrier. The barrier would be tied into the confining wall, and boots would be installed around groundwater monitoring and pumping wells. The geomembrane would serve to reduce infiltration of storm water runoff, and limit the future exposure to the subsurface contaminants.

The geomembrane would be covered with a minimum 3 feet of clean fill and landscaped for future recreational use. The offshore contaminated area would be backfilled until the site grade was at least 3 feet above the high water line, and the 2900N breakwater would become the new shoreline.

The filled in area could be potentially be used as a community park. Institutional controls would limit the potential for subsurface disturbances which might disturb the geomembrane layer. Long term monitoring would be utilized to detect any potential breaches in the containment system.

7.5.2 Long Term Effectiveness – Option C1

This option would not reduce the toxicity or volume of contamination, but it would significantly reduce the mobility. Human health risks and ecological risks would be reduced significantly because the exposure routes would be cutoff.

7.5.3 Short Term Effectiveness – Option C1

With the exception of trespassers during construction, short term human health risks from exposure to contaminants would be reduced by preventing access. Short term human risks of physical injury would be increased associated with the construction activities. The construction activities would not significantly disturb or increase exposures to the contamination.

7.5.4 Implementability – Option C1

This option may not be acceptable to the WDNR because it will not reduce the mass of contaminants. The community would be more likely to accept this option because it will not cause long term disruption to the community, and will create a larger community park area. There may be difficulties obtaining a permit to fill in 10 acres of Lake Superior. There are no significant concerns regarding constructability, availability, reliability, ease of undertaking further remedial action, or monitoring. There are no known endangered or threatened species present.

7.5.5 Restoration Time Frame - Option C1

This option is not expected to reduce the mass of contamination at the site within 100 years. However, the option will serve to restore the site within 2 to 5 years (after final approval of remedy) by confining the contamination and reducing the potential for further migration.

7.5.6 Costs – Option C1

The preliminary projection of total initial capital costs for this option is approximately $25,000,000. The projection includes costs for design data collection, and remedial action implementation. A detailed breakdown of the cost projection calculation is provided in Appendix C.

Annual operations, maintenance, and monitoring (OMM) costs are projected to be approximately $140,000 per year. OMM costs include the groundwater pumping and treatment system operation, quarterly monitoring, and maintenance of the site cap.

Capitalized total cost over a 40 year period for this option are projected to be approximately $28,000,000. OMM costs were converted to present worth at a net interest rate of 5%.

Annualized total costs were calculated to be approximately $1,600,000, assuming that the initial capital costs are amortized over 40 years at an interest rate of 5%.

7.5.7 Potential Future Liability – Option C1

This option is considered to have reduced relative liability because the contamination is confined and the potential for migration is reduced. However, the potential for future liability could be high, if a breach in the containment system resulted in exposures to the contaminants.

7.6 Option C2 – Engineering Controls/Confinement/Armored Sediment Cap

7.6.1 Description

Option C2 would be directed at reducing current and future exposures, minimizing the potential for future migration, and minimizing the potential for disturbance from anthropogenic or natural events. This option would include many of the items (utility rerouting, warning signs, institutional restrictions) discussed in Option B1 to immediately reduce risks as well as some additional engineering controls. Figure 7, "Option C2 – Engineering Controls/Confinement/Armored Sediment Cap" illustrates this option.

An impermeable subsurface confinement wall would be installed around the perimeter of the contaminated area to prevent further migration. Rather than installing a breakwater, low permeability sheetpiles would be installed along the 2900N grid line with 1 foot exposed above the sediment surface. The perimeter confinement wall would be keyed into the underlying Miller Creek aquitard. Low flow pumping would be conducted with in the confined area to maintain an internal gradient. A gravel trench hydraulic cutoff wall would be installed along the up gradient perimeter wall to capture migrating contaminants and prevent the contamination of areas lateral to the confined area. Water from the cutoff trench and internal gradient control system would treated and discharged to the sanitary system.

After the perimeter confining walls were installed, offshore wood pilings would be cut off and removed, the rip-rap would be removed from the current shoreline, and the park would be cleared and grubbed.

The park area (except the WWTP) and offshore contaminated sediments would be covered with one foot of clean sand followed by an impermeable synthetic geomembrane barrier. The barrier would be tied into the confining wall, and boots would be installed around groundwater monitoring and pumping wells. The geomembrane would serve to reduce infiltration of storm water runoff in the park, prevent bioturbation in the sediments, limit the contaminant diffusion to the surface, and limit the potential future exposure to the subsurface contaminants.

Offshore, the geomembrane would be sequentially covered with layers of coarse sand, gravel, and 18" armorstone. A subsurface mound of heavy armorstone would be installed along the 2900N cutoff to minimize the effects of wave action and ice plucking further inward.

In the landside areas, the geomembrane would be covered with a minimum 3 feet of clean fill and landscaped for future recreational use. The covered area could be potentially be used as a community park. Institutional controls would limit the potential for subsurface disturbances which might damage the geomembrane layer. Long term monitoring would be conducted to detect breaches in the containment system.

7.6.2 Long Term Effectiveness – Option C2

This option would not reduce the toxicity or volume of contamination, but it would significantly reduce the mobility. Human health risks and ecological risks would be reduced significantly because the exposure routes would be cutoff.

7.6.3 Short Term Effectiveness – Option C2

With the exception of trespassers, short term human health risks from exposure to contaminants would be reduced. Short term human risks of physical injury would be increased associated with the construction activities. The construction activities would not significantly disturb or increase exposures to the contamination.

7.6.4 Implementability – Option C2

This option may not be acceptable to the WDNR because it will not reduce the mass of contaminants. The community will likely accept this option because it will not cause long term disruption to the community, and will not significantly change the existing community park area.. There are no significant concerns regarding constructability, availability, reliability, or endangered or threatened species.

It would be difficult to monitor for migration of contaminants beyond the sediment cutoff wall should it be breached. Undertaking further remedial action at this site in the future would be complicated by the presence of the 18" armorstone and geomembrane.

7.6.5 Restoration Time Frame – Option C2

This option is not expected to reduce the mass of contamination at the site within 100 years. However, the option will serve to restore the site within 2 to 5 years (after final approval of remedy) by confining the contamination and reducing the potential for further migration..

7.6.6 Costs – Option C2

The preliminary projection of total initial capital costs for this option is approximately $21,000,000. The projection includes costs for design data collection, and remedial action implementation. A detailed breakdown of the cost projection calculation is provided in Appendix C.

Annual operations, maintenance, and monitoring (OMM) costs are projected to be approximately $140,000 per year. OMM costs include the groundwater pumping and treatment system operation, quarterly monitoring, and maintenance of the site cap.

Capitalized total cost over a 40 year period for this option are projected to be approximately $24,000,000. OMM costs were converted to present worth at a net interest rate of 5%.

Annualized total costs were calculated to be approximately $1,400,000, assuming that the initial capital costs are amortized over 40 years at an interest rate of 5%.

7.6.7 Potential Future Liability – Option C2

This option is considered to have reduced relative liability because the contamination is confined and the potential for migration is reduced. However, the potential for future liability could be high, if a breach in the containment system resulted in exposures to the contaminants.

7.7 Option D1 – Engineering Controls/Confinement/Thick Sediment Cap/In Situ Remediation

7.7.1 Description

Option D1 would be directed at reducing current and future exposures, minimizing the potential for future migration, minimizing the potential for disturbance from anthropogenic or natural events, and utilizing in situ treatment technologies to reduce the mass of contaminants. This option would include many of the items (utility rerouting, new breakwater along 2900N, warning signs, institutional restrictions) discussed in Option B1. Figure 8, "Option D1 – In Situ Remediation – Entire Site" illustrates this option.

An impermeable subsurface cutoff wall would be installed around the perimeter of the contaminated area to prevent further migration. The perimeter cutoff wall would be keyed into the underlying Miller Creek aquitard. Low flow pumping would be conducted within the confined area to maintain an internal gradient. A gravel trench hydraulic cutoff wall would be installed along the up gradient perimeter wall to capture migrating contaminants and prevent the contamination of areas lateral to the confined area. Water from the cutoff wall would be treated and discharged to the sanitary system.

After the new breakwater and perimeter confining walls have been installed, offshore pilings would be cut off and removed, the rip-rap would be removed from the current shoreline, and the park would be cleared and grubbed. The confined offshore area would be filled in with clean soil to approximately 1 foot above the lake high water line.

An aggressive remediation approach would be used initially to decrease the order of magnitude of contamination. In situ steam stripping would be applied across the site to remove the available fraction of NAPLs, VOCs, and lighter PAHs. The former WWTP building would be utilized to house treatment and handling equipment for the extracted contaminants, process water, and off-gases.

Due to the age of the contamination and heterogenous nature of the fill, a significant residual contaminant fraction is expected. Vertical and horizontal piping would be installed into the contaminated sediments and landside areas to be utilized for long term remediation. The remediation piping system would include systems for subsurface gas extraction, groundwater extraction, vadose zone flushing, and injection into the saturated zone.

The long term remediation process would include a combination of several remedial technologies including: the injection/vadose zone flushing/circulation of Fenton's reagent to breakdown long chain PAHs and thereby increase bioremediation potential; air sparging to enhance oxygen delivery in the saturated zone; vapor extraction from the vadose zone to maintain an inward pressure gradient and capture degradation off gases; groundwater pumping to maintain an inward gradient and/or to promote circulation. Following the Fenton's reagent circulation phase, nutrients and PAH degrading bacterium inoculum would be circulated into the subsurface to further promote bioremediation. The phased remediation of the residual contaminants would be over a 15 year period.

Once the phased remediation was complete, pumping wells and process piping would be removed. If residual contamination was above cleanup levels, gradient control pumping would continue within the confined area. The site would be covered with one foot of clean sand followed by an impermeable synthetic geomembrane barrier. The barrier would be tied into the confining wall, and boots would be installed around groundwater monitoring wells, pumping wells, and remediation piping headers. The geomembrane would serve to reduce infiltration of storm water runoff, and limit the future exposure to the subsurface contaminants. The geomembrane would be covered with a minimum 3 feet of clean fill and landscaped for future recreational use.

The filled in area could be potentially be used as a community park, once the remediation processes were stabilized. Institutional controls would limit the potential for subsurface disturbances which might damage the geomembrane layer.

7.7.2 Long Term Effectiveness – Option D1

This option would reduce the toxicity, mobility and volume of the contamination. After completion of the remedy, human health and environmental risks would be significantly reduced.

7.7.3 Short Term Effectiveness – Option D1

Short term human health and ecological risks would be reduced as the implementation of the remedy progressed. Short term risks from contaminant exposures could be potentially increased due to occasional spills or fugitive air emissions during the remediation, but efforts would be made to minimize these occurrences. Short term physical risks to workers, trespassers, and onlookers could increase during sitework.

7.7.4 Implementability – Option D1

This option should be acceptable to the community and WDNR because it will be protective of human health and the environment. The community may object to this option because the area will not be available to the community for 15 years. However, the community may not object because in the long run it could potentially create a larger park area. There may be difficulties in obtaining permits to fill a 10 acre portion of Lake Superior.

It is unlikely all of the contaminants will be removed or destroyed by the in situ remediation processes. There are no significant concerns regarding constructability, availability, ease of undertaking further remedial action, or monitoring. There are no known endangered or threatened species present.

7.7.5 Restoration Time Frame – Option D1

The in situ remediation is expected to significantly reduce the contamination during the initial two years of aggressive remediation, and then further reduce the contamination during the follow-up bioremediation (10 years). Site restoration would be expected within 15 years (after final approval).

7.7.6 Costs – Option D1

The preliminary projection of total initial capital costs for this option is approximately $37,000,000. The projection includes costs for design data collection, and remedial action implementation. A detailed breakdown of the cost projection calculation is provided in Appendix C.

Annual operations, maintenance, and monitoring (OMM) costs are projected to be approximately $140,000 per year. OMM costs include the groundwater pumping and treatment system operation, quarterly monitoring, and maintenance of the site cap.

Capitalized total cost over a 40 year period for this option are projected to be approximately $40,000,000. OMM costs were converted to present worth at a net interest rate of 5%.

Annualized total costs were calculated to be approximately $2,300,000, assuming that the initial capital costs are amortized over 40 years at an interest rate of 5%.

7.7.7 Potential Future Liability – Option D1

This option is considered to have low relative liability, because the mass of contaminants would be significantly reduced, and the remaining contamination would be contained.

7.8 Option D2 – Engineering Controls/Confinement/Nearshore Confined Treatment Facility for Sediments/In Situ Remediation

7.8.1 Description

Option D2 would be directed at reducing current and future exposures, minimizing the potential for future migration, minimizing the potential for disturbance from anthropogenic or natural events, and utilizing in situ treatment technologies to reduce the mass of contaminants. This option would include many of the items (utility rerouting, new breakwater along 2900N, warning signs, institutional restrictions) discussed in Option B1 to immediately reduce risks as well as some additional engineering controls. Figure 9, "Option D2 – In Situ Remediation With Confined Sediment Treatment Facility" illustrates this option.

An impermeable subsurface cutoff wall would be installed around the perimeter of the contaminated area to prevent further migration. The perimeter cutoff wall would be keyed into the underlying Miller Creek aquitard. Low flow pumping would be conducted within the confined area to maintain an internal gradient. A gravel trench hydraulic cutoff wall would be installed along the up gradient perimeter wall to capture migrating contaminants and prevent the contamination of areas lateral to the confined area. Water would be treated and discharged to the sanitary sewer.

After the new breakwater and perimeter confining walls were installed, offshore wood pilings would be cut off and removed, the rip-rap would be removed from the current shoreline, and the park would be cleared and grubbed.

Parallel sheetpile walls would be installed along the 2475N and 2500 N grid lines and keyed into the perimeter cutoff wall and lower Miller creek aquitard. Sediment would be dredged from the interior of the parallel walls to the top of the Miller Creek formation. The interior space would be filled with clean soils and bentonite to create an interior cutoff wall.

The area south of the 2475N cutoff wall would be utilized as a confined disposal facility for the dredged sediments. The sediments between the 2900N breakwater and the 2500N wall would be dredged to a depth of approximately 10 feet below lake bottom, and deposited in the sediment confined disposal facility. After dredging was complete, the north side of the 2500N wall would be stabilized to serve as the new shoreline.

During the dredging activities, temporary barriers would be utilized to prevent contamination of the shoreline and breakwater areas, and recontamination of previously dredged areas.

Sediment removal would likely involve a combination of hydraulic and mechanical dredging equipment. Hydraulic dredging would minimize the potential for volatile air emissions, however mechanical equipment would be required to be on site to remove large debris from the lake bottom. Sediment would be pumped to the tanks at the former WWTP for physical separation and dewatering. The coarse sandy materials and wood debris would be separated in the first tank and be mechanically removed and transported to the confined disposal facility. The suspended materials and water would be pumped to another tank and mixed with polymer to promote flocculation. The settling floc would be pumped to a filter press for dewatering and then mechanically removed and transported to the confined disposal area.

LNAPLs would be separated out via a coalescing separator and skimming device. The water would be pumped through a filter bag, an air stripper and granular activated carbon before being discharged back to the lake dredging area.

An aggressive remediation approach would be used initially to decrease the order of magnitude of contamination. In situ steam stripping would be applied across the site to remove the available fraction of NAPLs, VOCs, and PAHs. The former WWTP building would be utilized to house treatment and handling equipment for the extracted contaminants, process water, and off-gases.

Due to the age of the contamination and heterogenous nature of the fill, a significant residual contaminant fraction is expected. Vertical and horizontal piping would be installed into the contaminated sediments and landside areas to be utilized for long term remediation. The remediation piping system would include systems for subsurface gas extraction, groundwater extraction, vadose zone flushing, and injection into the saturated zone.

The long term remediation process would include a combination of several remedial technologies including: the injection/ vadose zone flushing/circulation of Fenton's reagent to breakdown long chain PAHs and thereby increase bioremediation potential; air sparging to enhance oxygen delivery in the saturated zone; vapor extraction from the vadose zone to maintain an inward pressure gradient and capture degradation off gases; groundwater pumping to maintain an inward gradient and/or to promote circulation. Following the Fenton's reagent circulation phase, nutrients and PAH degrading bacterium inoculum would be circulated into the subsurface to further promote bioremediation. The phased remediation of the residual contaminants would be over a 15 year period.

Once the phased remediation was complete, pumping wells and process piping would be removed. If residual contamination was above cleanup levels, gradient control pumping would continue within the confined area. The site would be covered with one foot of clean sand followed by an impermeable synthetic geomembrane barrier. The barrier would be tied into the cutoff wall, and boots would be installed around groundwater monitoring wells. The geomembrane would serve to reduce infiltration of storm water runoff, and limit the future exposure to the subsurface contaminants. The geomembrane would be covered with a minimum 3 feet of clean fill and landscaped for future recreational use.

The filled in area could potentially be used as a community park, once the remediation processes stabilized. Institutional controls would limit the potential for subsurface disturbances which might damage the geomembrane layer. The sediment dredge area could potentially be used as a protected marina, after an opening was made into the 2900N breakwater.

7.8.2 Long Term Effectiveness – Option D2

This option would reduce the toxicity, mobility and volume of the contamination. After completion of the remedy, human health and environmental risks would be significantly reduced.

7.8.3 Short Term Effectiveness – Option D2

Short term human health and ecological risks would be reduced as the implementation of the remedy progressed. During the sediment dredging, disturbance of the deeper more contaminated sediments could result in uncontrolled emissions of VOCs to the community. Short term risks from contaminant exposures could be potentially increased due to occasional spills or fugitive air emissions during the remediation, but efforts would be made to minimize these occurrences. Short term physical risks to workers, trespassers, and onlookers could increase during sitework.

7.8.4 Implementability – Option D2

This option should be acceptable to the community and WDNR because it will be protective of human health and the environment. The community may object to this option because of the community area will not be available for several years. However the community may accept this option because in the long run it might create a larger community park area, and potential site for marina expansion.

It is unlikely all of the contaminants will be removed or destroyed by the in situ remediation processes.

There are no significant concerns regarding constructability, availability, ease of undertaking further remedial action, or monitoring. There are no known endangered or threatened species present.

7.8.5 Restoration Time Frame – Option D2

The in situ remediation is expected to significantly reduce the contamination during the initial two years of aggressive remediation, and then further reduce the contamination during the follow-up bioremediation (10 years). Site restoration would be expected within 15 years (after final approval).

7.8.6 Costs – Option D2

The preliminary projection of total initial capital costs for this option is approximately $48,000,000. The projection includes costs for design data collection, and remedial action implementation. A detailed breakdown of the cost projection calculation is provided in Appendix C.

Annual operations, maintenance, and monitoring (OMM) costs are projected to be approximately $140,000 per year. OMM costs include the groundwater pumping and treatment system operation, quarterly monitoring, and maintenance of the site cap.

Capitalized total cost over a 40 year period for this option are projected to be approximately $51,000,000. OMM costs were converted to present worth at a net interest rate of 5%.

Annualized total costs were calculated to be approximately $2,900,000, assuming that the initial capital costs are amortized over 40 years at an interest rate of 5%.

7.8.7 Potential Future Liability – Option D2

This option is considered to have low relative liability, because the mass of contaminants would be significantly reduced, and the remaining contamination would be contained.

7.9 Option E1 – Engineering Controls/Confinement/Removal with Ex Situ Treatment and Backfill

7.9.1 Description

Option E1 would be directed at reducing current and future exposures, minimizing the potential for future migration, minimizing the potential for disturbance from anthropogenic or natural events, and a phased approach to removing and treating the contaminated materials. The sediments, soils, fill, and water would be removed and separated. Wood waste would be transported via rail to the Bayfront power plant to be used as fuel. Soil, coarse sediments, and dewatered fines would be thermally treated to destroy the organic contaminants and used as backfill for the site. NAPL would be disposed offsite or used in fuel blending. Water would be treated and discharged to the lake. Figure 10, "Option E1, E2 – Removal, Treatment of Dispose, and Backfill" illustrates this option.

This option would include many of the items (utility rerouting, new breakwater along 2900N, warning signs, institutional restrictions) discussed in Option B1 to immediately reduce risks as well as some additional engineering controls. An impermeable subsurface cutoff wall would be installed around the perimeter of the contaminated area to prevent further migration. The perimeter cutoff wall would be keyed into the underlying Miller Creek aquitard. Low flow pumping would be conducted within the confined area to maintain an internal gradient. A gravel trench hydraulic cutoff wall would be installed along the up gradient perimeter wall to capture migrating contaminants and prevent the contamination of areas lateral to the confined area.

After the new breakwater and perimeter cutoff walls were installed, offshore wood pilings would be cut off and removed, the rip-rap would be removed from the current shoreline, and the park would be cleared and grubbed. An interior cutoff wall would be installed along the shoreline and around the former WWTP building.

The phased removal process would begin with excavation of the west side of the park, using the east side of the park for staging, treatment, and storage. During the following three years, a section of the offshore sediments would be dredged and treated. Treated sediments would be stored and/or used for backfill on the western side of the park. In the final year, the treatment equipment would be moved to the western side of the park, and the eastern side would be remediated. Temporary barriers would be utilized to keep the sections separate and prevent recontamination. The confined area around the former WWTP area would not be excavated, but instead addressed by long term in situ remediation techniques, similar to those described in options D1 and D2.

Sediment removal would likely involve a combination of hydraulic and mechanical dredging equipment. Hydraulic dredging would minimize the potential for volatile air emissions, however mechanical equipment would be required to be on site to remove large debris from the lake bottom. Sediment would be pumped to the tanks at the former WWTP for physical separation and dewatering. The coarse sand would quickly settle out in the first tank, and the suspended solids would be pumped from the top of the receiving tank for further processing. The coarse sand would be pumped from the bottom of the tank to a dewatering basin. Surfactant would be injected into the effluent pipe to wash the coarse sand. The coarse sand would be mechanically removed from the basin, and sampled. If the coarse sand concentrations met the clean up goals it would be used as backfill. Otherwise it would be thermally treated. Wood debris would be mechanically removed, transported to a shredder for sizing, and transported via railcar to the Bayfront power plant. Polymer would be added to the suspended materials and water to promote flocculation. The settled floc would be pumped through a filter press for dewatering and then mechanically removed and transported to the thermal treatment unit. Treated sediments would be stored for use as backfill in the park area.

During the sediment dredging operation, groundwater pumping would also be performed on the landside to dewater the site for the pending excavation. Prior to excavating the landside area, air sparging and vapor extraction would be utilized to remove a portion of the available VOCs.

Excavation would be done under mobile, temporary structures to minimize the potential for airborne emissions to the surrounding community. Soils and wood materials would be separated. Wood waste would be processed through a shredder, loaded onto railcars, and transported to the Bayfront power plant for use as fuel. Soil would be thermally treated and reused as backfill on site.

Waters from the dewatering process would be treated with equipment in the former WWTP building. NAPLs would be separated out via a coalescing separator and skimming device. The water would be pumped through a filter bag, an air stripper and granular activated carbon before being discharged to the lake.

Treated soils would be graded across the park area, covered with a 1 foot layer of clean fill and topsoil and landscaped to be used as a community park again. Institutional controls would limit the potential for subsurface disturbances which might disturb the underlying Miller Creek aquitard. The sediment dredge area could potentially be used as a protected marina, after an opening was made into the 2900N breakwater.

7.9.2 Long Term Effectiveness – Option E1

This option would reduce the toxicity, mobility and volume of the contamination. After completion of the remedy, human health and environmental risks would be significantly reduced.

7.9.3 Short Term Effectiveness – Option E1

Short term human health risks would be increased during implementation of the remedy due to physical hazards and increased potential for exposure to the contaminants. A larger area of the community would be exposed to risks due to the transportation of the wood wastes off site. Engineering controls and safety measures would be utilized to limit the potential for increased exposures.

7.9.4 Implementability – Option E1

This option would be acceptable to the WDNR because after completion of the remedy it will be protective of human health and the environment. The community may object to this option because the community area will not be available for several years, and numerous site disruptions associated with increased traffic, noise, and activity. The new breakwater and dredged area could be used to expand the marina, which might make this option more acceptable to the community.

The power plant may have difficulties obtaining an air permit modification to burn the wood wastes.

There are no significant concerns regarding constructability, availability, ease of undertaking further remedial action, or monitoring. There are no known endangered or threatened species present.

7.9.5 Restoration Time Frame – Option E1

The site preparation, phased removal and treatment, and subsequent site restoration would likely take 6 to 8 years.

7.9.6 Costs – Option E1

The preliminary projection of total initial capital costs for this option is approximately $89,000,000. The projection includes costs for design data collection, and remedial action implementation. A detailed breakdown of the cost projection calculation is provided in Appendix C.

Annual operations, maintenance, and monitoring (OMM) costs are projected to be approximately $260,000 per year. OMM costs include the groundwater pumping and treatment system operation, quarterly monitoring, and maintenance of the site cap.

Capitalized total cost over a 40 year period for this option are projected to be approximately $93,000,000. OMM costs were converted to present worth at a net interest rate of 5%.

Annualized total costs were calculated to be approximately $5,400,000, assuming that the initial capital costs are amortized over 40 years at an interest rate of 5%.

7.9.7 Potential Future Liability – Option E1

Potential future liability with this option is considered to very low because a majority of the contaminants would be removed from the site and destroyed.

7.10 Option E2 – Engineering Controls/Confinement/Removal and Offsite Disposal/New Backfill

7.10.1 Description

Option E2 would be directed at reducing current and future exposures, minimizing the potential for future migration, minimizing the potential for disturbance from anthropogenic or natural events, and a phased approach to removing and disposing of the contaminated materials offsite at a licensed landfill. This option is very similar to option E1 except that the materials would not be separated (except for dewatering) and treated. Instead the contaminated soils and sediments would be removed, stabilized with lime, and transported via railcar to a landfill for disposal. Figure 10 illustrates this option.

This option would include many of the items (utility rerouting, new breakwater along 2900N, warning signs, institutional restrictions) discussed in Option B1 to immediately reduce risks as well as some additional engineering controls.

An impermeable subsurface cutoff wall would be installed around the perimeter of the contaminated area to prevent further migration. The perimeter cutoff wall would be keyed into the underlying Miller Creek aquitard. Low flow pumping would be conducted within the confined area to maintain an internal gradient. A gravel trench hydraulic cutoff wall would be installed along the up gradient perimeter wall to capture migrating contaminants and prevent the contamination of areas lateral to the confined area.

After the new breakwater and perimeter cutoff walls were installed, offshore wood pilings would be cut off and removed, the rip-rap would be removed from the current shoreline, and the park would be cleared and grubbed. An interior cutoff wall would be installed along the shoreline and around the former WWTP building.

The phased removal process would begin with excavation of the west side of the park, using the east side of the park for staging, treatment, and storage. During the following three years, a section of the offshore sediments would be dredged and treated. Treated sediments would be stored and/or used for backfill on the western side of the park. In the final year, the treatment equipment would be moved to the western side of the park, and the eastern side would be remediated. Temporary barriers would be utilized to keep the sections separate and prevent recontamination. The confined area around the former WWTP area would not be excavated, but instead addressed by long term in situ remediation techniques, similar to those described in options D1 and D2.

Sediment removal would likely involve a combination of hydraulic and mechanical dredging equipment. Hydraulic dredging would minimize the potential for volatile air emissions, however mechanical equipment would be required to be on site to remove large debris from the lake bottom. Sediment would be pumped to the tanks at the former WWTP for physical separation and dewatering. The coarse sand and wood debris would be mechanically removed, stabilized with lime and transported off site to a landfill. The suspended materials and water would be pumped to another tank and mixed with polymer to promote flocculation. The settled floc would be pumped through a filter press for dewatering and then mechanically removed and transported to the landfill.

During the sediment dredging operation, groundwater pumping would also be performed on the landside to dewater the site for the pending excavation. Prior to excavating a landside area, air sparging and vapor extraction would be utilized to remove a portion of the available VOCs.

Excavation would be done under mobile, temporary structures to minimize the potential for airborne emissions to the surrounding community. Soils and wood materials would be stabilized, loaded onto railcars, and transported to an offsite landfill.

Waters from the dewatering process would be treated with equipment in the former WWTP building. NAPLs would be separated out via a coalescing separator and skimming device. The water would be pumped through a filter bag, an air stripper and granular activated carbon before being discharged to the lake.

The excavated park area would be backfilled with clean fill. The filled in area could be potentially be used as a community park. Institutional controls would limit the potential for subsurface disturbances which might penetrate the underlying Miller Creek aquitard. The sediment dredge area could potentially be used as a protected marina, after an opening was made into the 2900N breakwater.

7.10.2 Long Term Effectiveness – Option E2

This option would reduce the toxicity, mobility and volume of the contamination. After completion of the remedy, human health and environmental risks would be significantly reduced.

7.10.3 Short Term Effectiveness – Option E2

Short term human health risks would be increased during implementation of the remedy due to physical hazards and increased potential for exposure to the contaminants. A larger area of the community would be exposed to risks due to the transportation of the contaminated materials off site. Engineering controls and safety measures would be utilized to limit the potential for increased exposures.

7.10.4 Implementability – Option E2

This option would be acceptable to the WDNR because after completion of the remedy it will be protective of human health and the environment. The community may object to this option because the community area will not be available for several years, and numerous site disruptions associated with increased traffic, noise, and activity. The new breakwater and dredged area could be used to expand the marina, which might make this option more acceptable to the community.

There may be difficulties associated with other communities not accepting the large volume of waste to be disposed into their nearby landfills.

There are no significant concerns regarding constructability, availability, ease of undertaking further remedial action, or monitoring. There are no known endangered or threatened species present.

7.10.5 Restoration Time Frame – Option E2

The site preparation, phased removal and treatment, and subsequent site restoration would likely take 6 to 8 years.

7.10.6 Costs – Option E2

The preliminary projection of total initial capital costs for this option is approximately $85,000,000. The projection includes costs for design data collection, and remedial action implementation. A detailed breakdown of the cost projection calculation is provided in Appendix C.

Annual operations, maintenance, and monitoring (OMM) costs are projected to be approximately $260,000 per year. OMM costs include the groundwater pumping and treatment system operation, quarterly monitoring, and maintenance of the site cap.

Capitalized total cost over a 40 year period for this option are projected to be approximately $89,000,000. OMM costs were converted to present worth at a net interest rate of 5%.

Annualized total costs were calculated to be approximately $5,200,000, assuming that the initial capital costs are amortized over 40 years at an interest rate of 5%.

7.10.7 Potential Future Liability – Option E2

This option is considered to have low potential future liability because the contaminants would be removed from the site. However low potential liability could be associated with exposure to migrating contaminants from the selected landfill.

7.11 Option E3 – Engineering Controls/Confinement/Removal and Ex Situ Disposal/No Backfill

7.11.1 Description

Option E3 would be directed at reducing current and future exposures, minimizing the potential for future migration, minimizing the potential for disturbance from anthropogenic or natural events, and a phased approach to removing, transporting and disposing of the contaminated materials offsite at a licensed landfill. This option is very similar to option E2 except that the former WWTP area would also be removed, and none of the excavated areas would be backfilled. Figure 11, "Option E3 – Complete Removal, No Backfill" illustrates this option.

This option would include many of the items (utility rerouting, new breakwater along 2900N, seep remediation, warning signs, institutional restrictions) discussed in Option B1 to immediately reduce risks as well as some additional engineering controls. An impermeable subsurface cutoff wall would be installed around the perimeter of the contaminated area to prevent further migration. The perimeter cutoff wall would be keyed into the underlying Miller Creek aquitard. Low flow pumping would be conducted with in the confined area to maintain an internal gradient. A gravel trench hydraulic cutoff wall would be installed along the up gradient perimeter wall to capture migrating contaminants and prevent the contamination of areas lateral to the confined area.

After the new breakwater and perimeter cutoff walls were installed, offshore wood pilings would be cut off and removed, the rip-rap would be removed from the current shoreline, and the park would be cleared and grubbed. An interior cutoff wall would be installed along the shoreline.

The phased removal process would begin with removal of the sediments, using the park for staging, treatment, and storage. Each year one of the sections would be addressed.

Sediment removal would likely involve a combination of hydraulic and mechanical dredging equipment. Hydraulic dredging would minimize the potential for volatile air emissions, however mechanical equipment would be required to be on site to remove large debris from the lake bottom. Sediment would be pumped to the tanks at the former WWTP for physical separation and dewatering. The coarse sand and wood debris would be mechanically removed, stabilized with lime and transported off site to a landfill. The suspended materials and water would be pumped to another tank and mixed with polymer to promote flocculation. The settled floc would be pumped through a filter press for dewatering and then mechanically removed and transported to the landfill.

During the sediment dredging operation, groundwater pumping would also be performed on the landside to dewater the site for the pending excavation. Water from the dewatering process would be treated with equipment in the former WWTP building. NAPLs would be separated via a coalescing separator and skimming device. The water would be pumped through a filter bag, an air stripper and granular activated carbon before being discharged to the lake.

Prior to excavating the landside area, air sparging and vapor extraction would be utilized to remove the available VOCs and minimize emissions during sitework. Excavation would be done under mobile, temporary structures to limit the potential for airborne emissions to the surrounding community. Air inside the mobile structures would be collected and treated. Workers would potentially be required to wear respirators inside the structures.

Excavated soils and wood materials would be stabilized, loaded onto railcars, and transported to an offsite landfill. The WWTP building would be demolished and disposed of at a demolition landfill. The entire contaminated area would be excavated.

The site would not be backfilled. Rip-rap would be installed along the new shoreline to prevent future erosion and to protect the railroad track. The impermeable perimeter cutoff wall and hydraulic cutoff trench would remain to limit the potential for recontamination of the remediated area.

The sediment dredge area could potentially be used as a protected marina, after an opening was made into the 2900N breakwater.

7.11.2 Long Term Effectiveness – Option E3

This option would reduce the toxicity, mobility and volume of the contamination. After completion of the remedy, human health and environmental risks would be significantly reduced.

7.11.3 Short Term Effectiveness – Option E3

Short term human health risks would be increased during implementation of the remedy due to physical hazards and increased potential for exposure to the contaminants. A larger area of the community would be exposed to risks due to the transportation of the contaminated materials off site. Engineering controls and safety measures would be utilized to limit the potential for increased exposures.

7.11.4 Implementability – Option E3

This option would be acceptable to the WDNR because after completion of the remedy it will be protective of human health and the environment. The community may object to this option because the community area would be removed, and the numerous site disruptions associated with increased traffic, noise, and activity. The new breakwater and dredged area could be used to expand the marina, which might make this option more acceptable to the community.

There may be difficulties associated with other communities not accepting the large volume of waste to be disposed into their nearby landfills.

There are no significant concerns regarding constructability, availability, ease of undertaking further remedial action, or monitoring. There are no known endangered or threatened species present.

7.11.5 Restoration Time Frame – Option E3

The site preparation, phased removal and treatment, building demolition, and subsequent installation of new protected shoreline would likely take 6 to 8 years.

7.11.6 Costs – Option E3

The preliminary projection of total initial capital costs for this option is approximately $76,000,000. The projection includes costs for design data collection, and remedial action implementation. A detailed breakdown of the cost projection calculation is provided in Appendix C.

Annual operations, maintenance, and monitoring (OMM) costs are projected to be approximately $140,000 per year. OMM costs include the groundwater pumping and treatment system operation, quarterly monitoring, and maintenance of the site cap.

Capitalized total cost over a 40 year period for this option are projected to be approximately $79,000,000. OMM costs were converted to present worth at a net interest rate of 5%.

Annualized total costs were calculated to be approximately $4,600,000, assuming that the initial capital costs are amortized over 40 years at an interest rate of 5%.

7.11.7 Potential Future Liability – Option E3

This option is considered to have low potential future liability because the contaminants would be removed from the site. However low potential liability could be associated with exposure to migrating contaminants from the selected landfill.

8.0 Comparison of Remedial Action Options

Table 7, "Comparison of Remedial Action Options" summarizes the evaluation of each option and utilizes a numerical scoring system for each evaluation criteria. The scoring system provides a balanced system to give equal weight to the six technical and economic criteria specified in s. NR 722.07(4). Rating for each criteria category was based upon the previous discussion for each option.

Scoring was based upon each options' relative rating when compared to the other options. A score of 1 to 10 was possible for each criteria. Low scoring indicates the best options in the criteria category.

The best possible total score was 6 and the worst possible total score was 60.

8.1 Long Term Effectiveness

Option A1 was rated "very poor" because no actions would be taken to reduce the long term risks. Option B1 was rated "poor" because the option would not reduce long term risks to trespassers, or non-human species which might be directly exposed to the contaminants. Options C1 and C2 were both rated "medium" because the potential for exposure to the contaminants would be reduced, but the contaminant mass would not be reduced and potential long term breaches in the containment systems could result in exposures. Options D1 and D2 were rated "good" because the remediation processes would significantly reduce the contaminant mass, and therefore exposures from potential future breaches in the containment system would not pose risks as high as the current scenario. Options E1, E2, and E3 were rated "very good" because the contaminants would be destroyed or transferred to an engineered landfill.

8.2 Short Term Effectiveness

Option A1 was rated "very poor" because no actions would be taken to reduce the short term risks. Option B1 was rated "poor" because the option would not reduce short term risks to trespassers, or non-human species which might be directly exposed to the contaminants. Options C1 and C2 were both rated "very good" because the potential for exposure to the contaminants would be reduced in the shortest time frame, and disturbance of the contaminants would be minimal, relative to the options. Options D1 was rated "good" because the potential for risk exposures to the contaminants would be reduced in a short time frame and disturbance of the contaminants would be minimal. Options D2, E1, E2, and E3 were rated "medium" because the potential for risk exposures would be reduced in a relatively short time frame, but the disturbances of the contaminants could result in higher short term risks from exposure.

8.3 Implementability

Options A1 and B1 were rated "very poor" because it is unlikely the WDNR or community would accept either of these options as they are not protective of human health or the environment, and would be in accordance with regulations. Options C1 and C2 were both rated "medium" because while both options are technically implementable and reduce short term and long term risks, they do not reduce the mass of contaminants and may not be acceptable by the WDNR. Options D1 and D2 were rated "good" because the both options are technically implementable, reduce short term and long term risks, and reduce the mass of contaminants, but the neither option will likely attain the ch. NR 140 or ch. NR 720 cleanup standards. Option E1 was rated "very good" because it would meet all of the remedial action objectives and meet the ch. NR 140 and ch. NR 720 cleanup standards. Option E2 is similar to E1, but only received a "medium" rating because the community near the landfill receiving the large volume of waste might aggressively object (based on the recent Fox River sediment disposal protests). Option E3 was rated "poor" because the Ashland community would likely object to losing the park area, and the receiving community might object to the large volume waste disposal.

8.4 Restoration Time Frame

Figure 12, "Remedial Action Option Timelines" illustrates and compares the years until each remedy would be completed, short term risks limited, contamination would be reduced significantly, and ch. NR 140 and ch. NR 720 cleanup goals would be attained.

Options A1 and B1 were rated as "very poor" because the site would not be restored. Option C1 was rated as "medium" because while the site would not be restored, the exposure to contaminants would be reduced and monitoring could be effectively be utilized to determine if future breaches did occur and repairs made. Option C2 was rated as "poor" because while the exposure to contaminants would be reduced it might be difficult to monitoring for future breaches and make repairs. Option D1 and D2 were rated as "good" because the site would be restored in a relatively short time frame, but would not likely ever meet the current ch. NR 140 and ch. NR 720 cleanup standards. Options E1, E2, and E3 were rated as "very good" because the remedial objectives and regulatory cleanup standards would be met in the shortest time period.

8.5 Costs

Scores for cost were selected based upon the options cost relative to the other options. Options A1 and B1 present the lowest cost options. Options C1 and C2 present the next lowest cost options. Options D1 and D2 are the middle range cost options. Options E1, E2, and E3 are the highest cost options.

8.6 Potential Future Liability

The potential future liability for options A1 and B1 are very high because of the document risks. Liability for options C1 and C2 are rated medium because the contaminants would be contained, but a potential does exist for future exposures. Liability for options D1, D2, E2, and E3 are rated as low because the potential for future exposures would exist, but less than for C1 or C2. Liability for option E1 is rated as very low because the contaminants would be destroyed and no future exposures would exist.

9.0 Recommendation

The in situ remediation options appear to present feasible approaches to meeting the remedial action objectives. SEH recommends that the WDNR consider the D1 and D2 options for implementation at this site. At the WDNR's request, SEH can provide further analysis of these options or additional alternatives.

10.0 Implementation

The WDNR will meet with responsible parties, the community, and other stakeholders prior to selection of the remedial alternative. Following selection of the alternative, completion of design studies, permit approvals, construction plans and specifications, and bidding may require two years prior to initiation of the remedy at the site.

11.0 Discussion

Several remedial approaches were presented. Each option was presented as a conceptual approach and costs presented were conservative to consider all potential costs. It was not within the scope of this FS to present a detailed design approach or estimate of costs or schedule. Once a final remedy is selected, design studies should be conducted to further define the cost, approach, permit requirements, and schedule.

12.0 Standard of Care

The conclusions and recommendations contained in this report were arrived at in accordance with generally accepted professional engineering practice at this time and location. Other than this, no warranty is implied or intended.

MJB/ls/GC/JEG/TB/CWI

13.0 References and Resources

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TABLES

Tables

Table 1 - TCLP Results
Ashland Lakefront Property & Contaminated Sediments

Sample ID	Date Sampled	Benzene soil concentration (ug/kg)	Benzene TCLP (mg/l)	Arsenic soil concentration (mg/kg)	Arsenic TCLP (mg/l)	Lead soil concentration (mg/kg)	Lead TCLP (mg/l)
Seep Soils (1'-2' interval)	2/23/98	***	< 0.10	5.3	< 0.70	68	< 0.20
Kreher Park Composite *	2/23/98	8300	0.38	3.3	< 0.70	52	< 0.20
Sediment Composite **	2/23/98	2400	< 0.10	1.3	< 0.70	4.6	< 0.20
Sediment 2400N, 1400E (0-2' interval)	2/23/98	***	0.24	1	< 0.70	2.6	< 0.20

Notes:

* The Kreher Park composite was collected from locations 1950N 1880E (5'-9'); 2000N 1600E (6'-10'); 2000N 1800E (4'-8'); 2000N 2000E (4'-8'); and 2060N 1800E (0-4')

** The Sediment composite was collected from stations 2400N 1400E (0-4'); 2600N 1900E (0-4'); and 2600N 2100E (0-4').

*** Not analyzed because VOC data is available for this location from previous sampling events.

Table 2
Review of Potential Chemical-Specific and Action-Specific Applicable or Relevant and Appropriate Requirements (ARARs) and Information To Be Considered (TBC)

Standard, Requirement, Criteria, or Limitation	Citation	Description	Comments
FEDERAL REQUIREMENTS			
CLEAN WATER ACT (Federal Water Pollution Control Act)	33 U.S.C.A. Sec. 1251-1387		
Ambient Water Quality Criteria	CWA Section 304; *Quality Criteria for Water*, U.S. EPA 1986	Establishes nonenforceable guidelines for States to set water quality standards for surface water. Criteria based on protection of aquatic life and human health.	ARAR only if concentrations of surface water above sediments exceed these criteria; otherwise becomes a cross-media check.
Water Quality Standards	SWA Section 303 40 CFR 131	Requires states to develop water quality standards based on federal guidelines.	ARAR only if concentrations of surface water above sediments exceed these criteria; otherwise becomes a cross-media check.
National Pollutant Discharge Elimination System (NPDES)	CWA Section 401 40 CFR 122, 123	Requires compliance with permit limitations for discharge to navigable waters, including water quality effluent limits, water quality standards, national performance standards, and toxic and pretreatment effluent standards.	NPDES program is administered by the state. (see Wisconsin NPDES Permit Regulations.) Potential ARAR for actions involving discharges of liquid effluent to surface water.
Water Quality Guidance for Great Lakes System	CWA Section 118 40 CFR 132	Establishes minimum water quality standards, antidegradation policies, and implementation procedures for the Great Lakes System.	Potential ARAR for actions involving discharges of effluent to surface waters and remedial actions for sediments.
Effluent Standards - Technology-Based Discharge Requirements	CWA Section 301(b)	Requires all direct discharges to be treated with best control technology or best available technology prior to discharge.	Not ARAR unless surface water is channeled directly to a surface water body via a ditch, culvert, storm sewer, or other means; or treated water is discharged.
Dredge and Fill Requirements	CWA Section 404 (Inland Testing Manual)	Regulates discharge of dredged or fill material to U.S. waters including wetlands. Testing manual establishes procedures for determining the potential for contaminant-related impacts associated with discharge of dredged material in inland waters.	Requires consideration of any practicable alternatives and may require protection of environmental values of the site. Includes testing protocols. Potential action-specific ARAR.
Proposed Sediment Quality Criteria	CWA Section 304; Sediment Quality Criteria, U.S. EPA; 1991	Establishes sediment quality standards that will not unacceptably affect benthic organisms.	Potential ARAR once promulgated; otherwise a potential TBC.
RESOURCE CONSERVATION AND RECOVERY ACT (Solid Waste Disposal Act)	42 U.S.C.A. 6901-6992k		
Definition of Hazardous Waste	40 CFR 261	Defines threshold levels and criteria to determine whether material is hazardous waste.	Potential ARAR for actions that involve management and land disposal of wastes.

Table 2 (Continued)
Review of Potential Chemical-Specific and Action-Specific Applicable or Relevant and Appropriate Requirements (ARARs) and Information To Be Considered (TBC)

Standard, Requirement, Criteria, or Limitation	Citation	Description	Comments
Land Disposal Restrictions (LDR)	40 CFR 268	Prohibits land use of specific RCRA hazardous wastes and defines treatment standards for most land disposal restricted wastes.	Potential ARARs for disposal actions that involve the management of wastes. Currently proposed LDR rules known as Phase IV (Federal Register 62 FR 26041) are proposing limiting the number of wastes currently exempt from LDR treatment standards by the Bevill Amendment. MGP wastes are currently excluded from LDR treatment standards under the Bevill exclusion, but Phase IV may potentially remove MGP wastes from the Bevill exclusion.
Treatment, Storage, and Disposal Facility Requirements	40 CFR 262, 264, 268	Defines prohibitions on storage, treatment, and disposal of hazardous wastes.	Potential ARAR for actions that involve the management of wastes.
CLEAN AIR ACT	42 U.S.C.A. 7401-7642		
National Ambient Air Quality Standards	CAA Section 109	Establishes ambient air quality standards for chemicals and particulates for certain sources.	Potential ARAR for actions that generate air emissions.
Hazardous Air Pollutants Program (NESHAP)	CAA Section 112	Requires EPA to promulgate standards for categories of sources of toxic air contaminants, using maximum achievable control technology (MACT) and residual risk standards.	Potential ARAR for specific remedial actions that generate air emissions including, but not limited to asbestos containing materials (ACM).
TOXICS SUBSTANCES CONTROL ACT	51 U.S.C. 2601, et . seq.; 40 CFR 761	Regulates the use, storage, and disposal of PCBs and PCB items. TSCA spill cleanup levels (10 ppm, 25 ppm, 50 ppm)	Potential ARAR for removal and disposal of PCB-containing devices in building to be demolished. Potential TBC.
Asbestos Abatement Projects - Worker Protection Rule	40 CFR 763; Subpart G	Regulations for asbestos control.	Potential ARARs for asbestos removal if former wastewater treatment building is demolished or renovated.
OCCUPATIONAL SAFETY AND HEALTH ACT	29 U.S.C. 651; et. seq.; 55 FR 45654 29 CFR 1900.120	Defines health and safety standards for employees engaged in hazardous waste operations.	Potential ARAR for any activity at contaminated sites.
	29 CFR 1926.1101	Health and safety standards for operations involving asbestos.	Demolition, construction, or renovation activities involving ACM.
DEPARTMENT OF TRANSPORTATION RULES FOR THE TRANSPORTATION OF HAZARDOUS MATERIALS	49 U.S.C. 1801, et. seq. 49 CFR Parts 107, 171, 172, 173 40 CFR 263 WIDOT	Establishes standards and procedures for the transportation of hazardous materials.	Potential ARAR for any movement of hazardous materials offsite.

Table 2 (Continued)
Review of Potential Chemical-Specific and Action-Specific Applicable or Relevant and Appropriate Requirements (ARARs) and Information To Be Considered (TBC)

Standard, Requirement, Criteria, or Limitation	Citation	Description	Comments
GREAT LAKES PROGRAM OFFICE - SEDIMENT EFFECTS CONCENTRATIONS (SECs)		Concentration levels of chemicals below which toxic effects are rarely observed. The SECs were developed by the National Biological Society.	Potential TBC for determining which chemicals could potentially cause adverse effects on biological activities at the site.
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION (NOAA) STATUS AND TRENDS PROGRAM	Document Title: The Potential for Biological Effects of Sediment-Sorbed Contaminants Tested in the National Status and Trends Program, NOAA Technical Memorandum NOS OMA52, August 1991	Identifies sediment contaminant levels expected to have no adverse biological effects or minor adverse biological effects. Based on toxicological studies.	Potential TBC.
ONTARIO PROVINCIAL SEDIMENT QUALITY GUIDELINES	Document Title: Guidelines for the Protection and Management of Aquatic Sediment Quality in Ontario, August 1993	Establishes guidelines for the protection and management of aquatic sediment quality in Ontario.	Potential TBC.
STATE REQUIREMENTS			
WISCONSIN STATE-FISH, GAME AND ENFORCEMENT, FORESTRY AND RECREATION	WAC NR 1-		
Endangered and Threatened Species Rules	WAC NR 27	Governs the transportation (among other things) of endangered and/or threatened species.	Potential ARAR for removal, transport, and disposal of contaminated sediments.
WISCONSIN STATE ENVIRONMENTAL PROTECTION - GENERAL	WAC NR 100-		
Wisconsin Water Quality Standards for Wisconsin Surface Waters	WAC NR 102 - 106	Establishes definition of water use and criteria for protection of public health and enjoyment and protection and propagation of fish, shellfish, and wildlife.	Potential ARAR only if concentrations of surface water above sediments exceed these criteria.
Water Quality Standards for Great Lakes System - Lake Superior	Regulations have not been promulgated yet, sent to EPA 8/97	Enforceable requirements from GLI federal EPA guidelines.	Potential ARAR for discharge of effluent to surface waters.
Groundwater Quality	WAC NR 140	Establishes groundwater quality standards for substances detected or having reasonable probability of entering groundwater resources.	Potential ARAR for groundwater contamination identified at the site and for removal, transport, and disposal of contaminated sediments (impacts to groundwater).

Table 2 (Continued)
Review of Potential Chemical-Specific and Action-Specific Applicable or Relevant and Appropriate Requirements (ARARs) and Information To Be Considered (TBC)

Standard, Requirement, Criteria, or Limitation	**Citation**	**Description**	**Comments**
Proposed Public Health Groundwater Quality Standards	Standards to be added to WAC NR 140 Groundwater Quality Standards	Establishes proposed groundwater quality standards for substances of health concern per recommendation of the Department of Health and Social Services	Potential ARAR after inclusion in WAC NR 140.
Management of PCBs and Products Containing PCBs	WAC NR 157	Establishes procedures for the storage, collection, transportation, processing, and final disposal of PCBs and materials containing PCBs.	Potential ARAR for removal, transport, and disposal of PCB-containing devices in building to be demolished.
WISCONSIN STATE ENVIRONMENTAL PROTECTION - WISCONSIN POLLUTANT DISCHARGE ELIMINATION SYSTEM (WPDES)	WAC NR 200-	Requires compliance with permit limitations for discharge to navigable waters, including water quality effluent limits, water quality standards, State performance standards, and toxic and pretreatment effluent standards.	Potential ARAR for actions involving discharges of liquid effluent to surface water.
WISCONSIN STATE ENVIRONMENTAL PROTECTION - AIR POLLUTION CONTROL REGULATIONS	WAC NR 400-	Establishes concentration levels, by chemical, for new sources.	Potential action-specific ARAR for removal, treatment, and disposal of VOC, PAH, metals contaminated sediments, soil, and groundwater. Potential ARAR for asbestos demolition and disposal.
WISCONSIN STATE ENVIRONMENTAL PROTECTION - HAZARDOUS WASTE MANAGEMENT	WAC NR 600-		
Identification and Listing of Hazardous Waste	WAC NR 605, Ch. 291 Wis. Stats.	Establishes criteria for identifying the characteristics of hazardous waste to determine if the waste is subject to regulation.	Potential ARAR for removal, transport, and disposal of contaminated sediments.
WISCONSIN STATE ENVIRONMENTAL PROTECTION - INVESTIGATION AND REMEDIATION	WAC NR 700-		
Notification of the Discharge of Hazardous Substances	WAC NR 706	Notification procedures and responsibilities by discharger of hazardous substances including containment, cleanup, disposal, and restoration	Potential ARAR for removal, transport, and disposal of contaminated sediments.
Site Investigations	WAC NR 716	Establishes criteria to ensure that site investigations provide adequate investigative information to determine a remedial action option.	Potential ARAR for site investigation activities.

Table 2 (Continued)
Review of Potential Chemical-Specific and Action-Specific Applicable or Relevant and Appropriate Requirements (ARARs) and Information To Be Considered (TBC)

Standard, Requirement, Criteria, or Limitation	Citation	Description	Comments
Soil Cleanup Standards	WAC NR 720	Establishes residual contaminant levels based on protection of groundwater and protection of human health from direct contact with contaminated soil.	Potential ARAR for contaminated soils.
Interim Guidance for Soil Cleanup levels for Polycyclic Aromatic Hydrocarbons (PAHs)	WDNR PUBL RR-519-97	Provides interim guidance on suggested soil cleanup levels for PAHs.	Potential ARAR for contaminated soils.
Standards for Selecting Remedial Actions	WAC NR 722	Establishes minimum standards for identifying and evaluating remedial action options and selecting remedial actions.	Potential ARAR.
WISCONSIN DEPARTMENT OF NATURAL RESOURCES SEDIMENT QUALITY GUIDELINES	WDNR, 1985; 1990	Sediment criteria based on environmental risk used primarily for in-water disposal of dredged material. Values for metals, pesticides, and other chlorinated organics are derived using a background comparison approach. More recent data based on equilibrium partitioning approach.	Guidelines only, no State regulatory basis, potential TBC.
	Document Title: "Assessing Sediment Quality in Water Bodies Associated with Manufactured Gas Plant Sites," WDNR PUBL-WR-447-96, March 1996	Provides framework for investigating potential surface problems at MGP sites.	Guidance document from the WDNR, potential TBC.
WISCONSIN DEPARTMENT OF NATURAL RESOURCES GENERAL INTERIM GUIDANCES	Document Title: "Repeal of Temporary Suspension on Approval of and General Interim Guidance for the Use of Hydrogen Peroxide/Catalyst Injection (a.k.a. Fenton's Reagent)," WDNR PUBL-RR-583, December 1, 1997	Provides guidelines for using Fenton's reagent at remedial sites.	Guidance document from the WDNR, potential TBC.
WISCONSIN DEPARTMENT OF HEALTH AND FAMILY SERVICES			
Asbestos Certification and Training Accreditation	ch. HSS 159 (may change to HFS)	Establishes training course requirements for asbestos abatement	Potential ARAR for asbestos removal during possible building demolition.

Table 3
Review of Potential Location-Specific and Action-Specific ARARs and TBCs

Standard, Requirement, Criteria, or Limitation	Citation	Description	Comments
Federal Requirements			
CLEAN WATER ACT (Federal Water Pollution Control Act)	33 U.S.C.A. 1251-1387 40 CFR 407, 122	Discharges to municipal sewers; discharges from pretreatment processes, storm water, etc.	Potential action and location specific ARAR.
Construction Activities Dredge or Fill Requirements	CWA Sections 401, 404 40 CFR 230, 33 CFR 320-330	Requires coordination with the U.S. Army Corps of Engineers and permits to conduct activities that are located near navigable waters. Protection of wetlands is a primary goal of the dredge and fill permit program.	Potential action and location specific ARAR.
EXECUTIVE ORDER ON PROTECTION OF WETLANDS	Executive Order 11990 40 CFR 6, Appendix A	Requires federal agencies to take action to avoid adversely impacting wetlands, to minimize wetland destruction, and to preserve the value of wetlands.	Potential action and location specific ARAR.
EXECUTIVE ORDER ON PROTECTION OF FLOODPLAINS	Executive Order 11988 40 CFR 6, Appendix A	Requires federal agencies to take action to avoid adversely impacting floodplains, to minimize floodplain destruction, and to preserve the value of floodplains.	Potential action and location specific ARAR.
WATER QUALITY GUIDANCE FOR THE GREAT LAKES SYSTEM/GREAT LAKES WATER QUALITY INITIATIVE	40 CFR 132	Identifies minimum water quality standards, antidegradation policies, and implementation procedures for the Great Lakes System.	Potential action and location specific ARAR.
FISH AND WILDLIFE COORDINATION ACT	16 U.S.C.A. 61-66 40 CFR 630	Requires federal agencies to take into consideration the effect that impoundments, diversions or modifications would have on fish and wildlife and to take action to prevent loss or damage to these resources.	Potential action and location specific ARAR.
NATIONAL ARCHAEOLOGICAL HISTORICAL PRESERVATION ACT	16 U.S.C.A. 469a-1	Requires any federal construction project or federally approved project to preserve significant scientific, prehistorical, or archeological data.	Potential action and location specific ARAR.
ENDANGERED SPECIES ACT	16 U.S.C.A. Sections 1531-144 59 CFR 17, 81, 222, 225, 402, 50-453	Action to conserve endangered species or threatened species.	Potential action and location specific ARAR.
COASTAL ZONE MANAGEMENT ACT	16 U.S.C.A. 1451-1464	Dredging, in situ capping, and any construction within a coastal zone.	Potential action and location specific ARAR.
NATIONAL RIVER AND HARBOR ACT SECTION 10	33 U.S.C.A. 403	Regulates all structures or work below the mean high water mark of navigable tidal waters.	Potential action and location specific ARAR.
OCCUPATIONAL HEALTH AND SAFETY ACT	29 U.S.C.A. Section 651 et. seq., 1910	Requires a formal hazard analysis of the site and development of a site-specific plan for worker protection	Applicable to all field activities.

Table 3 (Continued)
Review of Potential Location-Specific and Action-Specific ARARs and TBCs

Standard, Requirement, Criteria, or Limitation	Citation	Description	Comments
STATE REQUIREMENTS			
WISCONSIN STATE ENVIRONMENTAL PROTECTION - GENERAL	WAC NR 102-106, 207	Water quality based effluent limits designed to protect fish and aquatic life, wild and domestic animals, and human health.	Potential action and location specific ARAR.
	WAC NR 108 ch. 281 Wis. Stats.	WDNR approval of all wastewater treatment and conveyance systems prior to construction in accordance with ch. 281 Wis. Stats.	Potential action and location specific ARAR.
Wisconsin's Shoreland Management Program	WAC NR 115	Establishes protection of wetlands and other sensitive areas within designated shoreline areas.	Potential action and location specific ARAR.
Wisconsin's Floodplain Management Program	WAC NR 116	Requires the State to take action to avoid adversely impacting floodplains, to minimize floodplain destruction, and to preserve the value of floodplains.	Potential action and location specific ARAR.
Wisconsin's City and Village Shoreland-Wetland Protection Program	WAC NR 117	Establishes minimum standards to accomplish State shoreland protection objectives.	Potential action and location specific ARAR.
Wisconsin's Nonpoint Source Pollution Abatement Program	WAC NR 120		Potential action and location specific ARAR.
WISCONSIN ENVIRONMENTAL POLICY ACT	WAC NR 150	Evaluation criteria to ascertain the effects of major projects on the environment.	Potential action and location specific ARAR.
WISCONSIN STATE ENVIRONMENTAL PROTECTION - WPDES	WAC NR 220-297	Technology based effluent limits.	Potential action and location specific ARAR.
WISCONSIN STATE ENVIRONMENTAL PROTECTION - WATER REGULATION	WAC NR 300-		
Wisconsin's General Permit Program for Certain Water Regulatory Permits	WAC NR 322	Establishes minimum design standards and specifications for projects permitted under a general permit.	Potential action and location specific ARAR.
Dredging Contract Fees	WAC NR 346	Establishes procedures applicable to the removal of material from the beds of natural lakes and outlying waters for which a contract is required between the State and person desiring to remove bed material in accordance with s. 30.20 Wis. Stats.	Potential action-specific ARAR for removal, transport, and disposal of sediments.
Sediment Sampling and Analysis, Monitoring Protocol, and Disposal Criteria for Dredging Projects	WAC NR 347	Establishes procedures and protocols for sediment sampling and analysis, disposal criteria, and monitoring requirements for dredging projects regulated by the State of Wisconsin.	Potential action-specific ARAR for removal, transport, and disposal of sediments.

Table 3 (Continued)
Review of Potential Location-Specific and Action-Specific ARARs and TBCs

Standard, Requirement, Criteria, or Limitation	Citation	Description	Comments
WISCONSIN STATE ENVIRONMENTAL PROTECTION - SOLID AND HAZARDOUS WASTE MANAGEMENT	WAC NR 500-	Provides definitions, submittal requirements, exemptions and other general information relating to solid waste facilities which are subject to regulations under s. 289.01 to 289.97 Wis. Stats.	Potential action-specific ARAR.
WISCONSIN STATE ENVIRONMENTAL PROTECTION - HAZARDOUS WASTE MANAGEMENT	WAC NR 600-	Provides definitions, general permit application information, incorporation by reference citations and general information concerning the hazardous waste management program. Applies to those who generate, transport, recycle, store, treat or dispose of solid waste under NR 605.04	Potential action-specific ARAR.
WISCONSIN STATE ENVIRONMENTAL PROTECTION - INVESTIGATION AND REMEDIATION OF ENVIRONMENTAL CONTAMINATION	WAC NR 700-	Establishes standards and procedures that allow for site-specific flexibility, pertaining to the identification, investigation, and remediation of sites and facilities which are subject to regulation under s. 292.11, 292.15, 292.31, or 292.41 Wis. Stats	Potential action and location specific ARAR.

City Requirements	Citation	Description	Comments
Ashland City Ordinances	Ordinance #202	Noise Regulations	Potential action-specific ARAR.
	Ordinance #781.18	Zoning Regulations	Potential location specific ARAR.
	Ordinance #462	Shoreland-Wetland Regulations	Potential location specific ARAR.
	Ordinance #502	City Streets Regulations	Potential location and action specific ARAR.
	Ordinance #503	Heavy Traffic Regulations	Potential location and action specific ARAR.
	Ordinances #711 and #712	Sanitary Sewer Regulations	Potential action-specific ARAR.

Table 4: General Response Actions - Technology Screening

General Response Action	Technology	Implementability	Relative Cost	Status
Institutional Controls	Deed Restrictions	No significant issues	Low	Retained
	Legal Restrictions	No significant issues	Low	Retained
	Trespassing Prosecution	May be difficult to enforce	Medium	Possible later addition
Access Restrictions	Posted Warnings	No significant issues	Low	Retained
	Fence	No significant issues	Low	Retained
	Fence - Barbed	Safety issue in Public Area	Low	Possible later addition
	Fence - Electrified	Safety issue in Public Area	Medium	Not retained
	Security Guard	No significant issues	Medium	Possible later addition
	Video Surveillance	No significant issues	Medium	Possible later addition
Engineering Controls -Landside	Sheet Pile	Possible vibration/penetration Issues	Medium	Retained
	Slurry Wall	Insufficient area for installation	Medium	Possible VE alternative
	Grout Wall	No significant issues	Medium	Possible VE alternative
	Geomembrane	No significant issues	Medium	Retained
	Soil Cover	May not be sufficient alone	Low	Retained
	Hydraulic Cutoff Trench	No significant issues	Medium	Retained
	Internal Gradient Pumping	No significant issues	Medium	Retained
Engineering Controls - Offshore	Breakwater	No significant issues	High	Retained
	Silt Curtains	Would not prevent dissolved migration	Low	Not retained
	SheetPile	Possible Miller Creek penetration	Medium	Retained
	Thin Soil Cap	Would not handle wave action/ice scour	Low	Not retained
	Thick Soil Cap	Would work if higher than high water line	Low	Retained
	Armored Cap	No significant issues	Medium	Retained
	Geomembrane	Requires soil cover	Medium	Retained
	Bentonite Cap	Require soil cover for wave action.	Medium	Possible VE alternative
In situ Treatment	Soil Vapor Extraction	Would primarily address VOCs	Low	Retained for pretreatment
	Air Sparging / Biosparging	Would primarily address VOCs	Low	Retained for pretreatment
	Steam Stripping	No significant issues	Medium	Retained
	Radio Frequency Heating	No significant issues	Medium	Possible VE alternative
	Hot Water Flushing	No significant issues	Medium	Possible VE alternative
	Surfactant Flushing	No significant issues	Medium	Possible VE alternative
	Alcohol Flushing	No significant issues	Medium	Possible VE alternative
	Oxidation (Fenton's Reagent)	Free NAPL must be removed first	Medium	Retained
	In situ Soil Mixing	Inefficient due to wood slabs	Medium	Not retained
	In situ Solidification	Inefficient due to wood slabs	Medium	Not retained
	Enhanced Microbial Bioremediation	Require pretreatment of long chain PAHs	Low	Retained
	White Rot Fungi Remediation	Require pretreatment of long chain PAHs	Low	Possible VE alternative
	Phytoremediation	Good polishing technology	Low	Possible later addition
	Treatment Walls	Downgradient clean is offshore	Medium	Not retained
Excavation - Landside	Single Season - Major Excavation	Large volume would make logistics difficult	Medium	Not retained
	Several Season - Phased Approach	No significant issues	Medium	Retained
Sediment Dredging	Hydraulic	Would not handle wood slab	Medium	Retained
	Mechanical	Difficult to control odor	Medium	Retained
	Dewatered Excavation	Difficult to control odor	Medium	Possible VE alternative
Physical Separation	Trommel	Tar may be an issue	Medium	Retained
	Gravity Separator	Tar may be an issue	Medium	Retained
Solids Dewatering	Drying Beds	No significant issues	Low	Retained
	Vacuum Belt/Drum Filtration	Tar may be an issue	High	Not retained
	Filter Press	No significant issues	Medium	Retained
	Drying Agents	No significant issues	Low	Retained
	Solar Drying	Not feasible in cold region	Low	Not retained
	Kiln Drying	Not available	High	Not retained
Transportation	Railroad	No significant issues	Medium	Retained
	Truck	No significant issues	Medium	Retained
	Barge	No significant issues	Medium	Possible VE alternative
	Pipeline	Difficult for slab woods	Medium	Not retained
Ex situ Solids Treatment	Solidification/Stabilization	No significant issues	Medium	Possible VE alternative
	Soil Washing	No significant issues	Medium	Retained
	Thermal Desorption	No significant issues	Medium	Retained
	Bioreactors	Would not treat long chain PAHs	Medium	Not retained
	Landfarming	Volume too large, long chain PAHs, NIMBY	Low	Not retained
Ex situ Process Incorporation/ Co Treatment	Asphalt Batch Plant	Wood wastes unacceptable	Medium	Retained
	Utility Boiler Co-burning	Good for Wood waste	Medium	Retained
	Brick or Cement Kiln	Not available	High	Not retained
	Fuel Blending (NAPLs)	Good for NAPLs	Low	Retained
Disposal	Existing Landfills	May be unacceptable to receiving community	Medium	Retained
	Dedicated Landfill	May be unacceptable to receiving community	Medium	Possible VE alternative
	Confined Disposal Facility	None available in Chequamegon Bay	Low	Not retained
Water Treatment - NAPL Separation	Oil/Water Separators	No significant issues	Medium	Retained
	Dissolved Air Flotation	No significant issues	High	Retained
	Centrifugation	No significant issues	High	Possible VE alternative
- Suspended Solids Removal	Gravity Settling	No significant issues	Medium	Retained
	Flocculent Settling	No significant issues	Medium	Retained
	Filtration	No significant issues	Medium	Retained
- Dissolved Organics Removal	Air Stripping	No significant issues	Medium	Retained
	Carbon Adsorption	No significant issues	Medium	Retained
	UV Oxidation	No significant issues	Medium	Possible VE alternative
	Bioreactors	Would not treat long chain PAHs	Medium	Possible VE alternative
- Dissolved Inorganics Removal	Chemical Precipitation	No significant issues	Medium	Possible later addition
	Reverse Osmosis	No significant issues	Medium	Not retained
	Ultrafiltration	No significant issues	High	Not retained
	Electrostatic Precipitation	No significant issues	High	Not retained
Water Disposal	Sanitary Sewer Discharge	Low flow only	Medium	Retained
	Surface Water Discharge	High treatment required	Low	Retained
	Tanker Truck	Large volumes prohibitive	High	Not retained
	Evaporation	Cold weather climate	High	Not retained
Off Gas Control / Treatment	Foam Suppression	No significant issues	Medium	Possible VE alternative
	Temporary Structures	No significant issues	Medium	Retained
	Thermal Oxidation	No significant issues	Medium	Retained
	Carbon Adsorption	No significant issues	Medium	Retained
	Air Scrubbing	Residuals require disposal	High	Not retained
	Biofiltration	No significant issues	Medium	Possible VE alternative

Notes:
1. Costs for each technology are relative to each other in the same general response action. "Medium" indicates no significant difference in cost between technologies.
2. "Retained" technologies were utilized in one or more remedial action option.
3. "Not retained" technologies will not be considered any further.
4. "Possible later additions" were not utilized, but may be required after future design analysis
5. "Possible VE alternatives" are technologies which could be reconsidered during Value Engineering phase, after selection of remedial approach.

Table 5 - Summary of Microbial Enumeration Assay Results

	Recommended Passive Remediation Value - WDNR	1998 Anaerobic Enumeration Assay Results (Mean)		
Sample ID		BE-1	BE-2	BE-3
Grid Location		2400N 1400E	2600N 1900E	2600N 2100E
Sample Inteval (ft)		2-3	2-3	2-3
In Contaminated Area?		yes	yes	no
Populations				
Total Population (cfu/g)		< 1E+02	4.5 E+03	5.2E+03
Degrader Populaion (cfu/g)	>1E+06	< 1E+02	< 1E+02	1.2 E+02

	Recommended Passive Remediation Value - WDNR	1996 Aerobic Enumeration Assay Results (Mean)					
Sample ID		BIO-1	BIO-2	BIO-3	BIO-4	BIO-5	BIO-6
Grid Location		2300N 1600E	2400N 1600E	2400N 2000E	2400N 2000E	2500N 1600E	2900N 1600E
Sample Inteval (ft)		0 - 4	0 - 4	0 - 4	4 - 8	0 - 4	0 - 4
In Contaminated Area?		yes	yes	yes	yes	yes	no
Populations							
Total Population (cfu/g)		7.0E+04	7.4 E+05	3.7E+06	8.3E+03	2.3E+04	1.8E+04
Degrader Population (cfu/g)	>1E+06	2.2E+03	4.8E+03	1.5E+04	5.1E+01	3.4E+02	5.5+02

Table 6: Summary of Contaminant Dispersion / Sediment Settling Study Results

	Initial Composite Sediment	Settled Sand after Initial Mix	After Floc Fine Slurry 17.1% Solids
%Gravel	4.4	6	0
%Sand	65.5	75.2	0
%Fines	30.1	18.8	100
PAHs	(ug/kg)	(ug/kg)	(ug/kg)
Acenapthene	86,000	17,000	470,000
Acenapthylene	<2800	<1000	43,000
Anthracene	43,000	7,100	310,000
Benzo(a)anthracene	16,000	3,500	140,000
Benzo(a)pyrene	12,000	1,700	150,000
Benzo(b)flouranthene	6,200	<1000	93,000
Benzo (ghi) perylene	4,800	<1100	68,000
Benzo (k) flouranthene	6,000	<1000	79,000
Chrysene	15,000	2,800	130,000
Dibenzo(a,h) anthracene	<2900	<1100	19,000
Flouranthene	38,000	8,900	300,000
Fluorene	46,000	8,300	300,000
Indeno(123-cd)pyrene	3,700	<1100	53,000
1-Methylnaphthalene	90,000	21,000	390,000
2-Methylnaphthalene	150,000	36,000	590,000
Naphthalene	240,000	60,000	480,000
Phenanthrene	120,000	25,000	890,000
Pyrene	56,000	13,000	510,000
Total PAHs	932,700	204,300	5,015,000
VOCs			
Benzene	2,700	380	not analyzed
n-Butylbenzene	2,000		
Ethylbenzene	19,000	3,600	
Isopropylbenzene	2,100		
p-Isopropylbenzene	2,000	350	
Toluene	7,800	930	
1,2,4 -Trimethylbenzene	12,000	1,900	
1,3,5 -Trimethylbenzene	3,500	630	
Xylenes -m,-p	12,000	2,100	
Xylenes -o	6,500	1,000	
Total VOCs	**69,600**	**10,890**	

					Compared to Water Quality Criteria			
	3/31 Initial Sediment Slurry	4/2/98 Mixture after 2 days settling	4/11/98 Mixture after 11 days settling	Clear Water After Floc	NAWQ Acute Value (ug/l)	NAWQ Chronic Value (ug/l)	Tier II Acute Value (ug/l)	Tier II Chronic Value (ug/l)
TSS (g/l)	4.6	1.8	1.4	0.03				
PAHs	(ug/l)	(ug/l)	(ug/l)	(ug/l)				
Acenapthene	460	370	420	30	80	23		
Acenapthylene	<210	35	46	< 8.2				
Anthracene	240	82	88	15			13	0.73
Benzo(a)anthracene	61	23	25	7			0.49	0.027
Benzo(a)pyrene	64	33	35	6			0.24	0.014
Benzo(b)flouranthene	37	15	15	4				
Benzo (ghi) perylene	32	<10	11	3				
Benzo (k) flouranthene	21	8	9	2				
Chrysene	59	23	24	6				
Dibenzo(a,h) anthracene	28	20	24	4				
Flouranthene	170	71	75	20	33.6	6.16		
Fluorene	140	78	96	13			70	3.9
Indeno(123-cd)pyrene	84	27	29	7				
1-Methylnaphthalene	540	450	570	<7.2			37	2.1
2-Methylnaphthalene	810	480	740	<7.2				
Naphthalene	1,800	450	1,600	<8.4			190	12
Phenanthrene	720	210	310	27	30	6.3		
Pyrene	270	120	120	30				
Total PAHs	**5,536**	**2,495**	**4,237**	**174**				
VOCs								
Benzene	230	97	73	not analyzed			2300	130
n-Butylbenzene	<14	<14	9					
Ethylbenzene	810	280	210				130	7.3
Isopropylbenzene	36	24	18					
p-Isopropylbenzene	16	17	<6					
Methylene Chloride	24	31	<9				26000	2200
Toluene	410	190	130				120	9.8
1,2,4 -Trimethylbenzene	220	160	130					
1,3,5 -Trimethylbenzene	61	45	35					
Xylenes -m,-p	500	260	200				32	1.8
Xylenes -o	270	140	110					
Total VOCs	**2,577**	**1,244**	**915**					

TABLE 7: Comparison of Remedial Action Options

Project: Ashland Lakefront Property FS
SEH# WIDNR9401
CALC'D 'BY: MJB 10-Dec-98
CHECKED BY: CWI

Remedial Action Options:	Option A1 No Further Action		Option B1 Access Restrictions & Institutional Controls		Option C1 Engineering Controls Thick Sediment Cap		Option C2 Engineering Controls Armored Cap		Option D1 In Situ Remediation Entire Site		Option D2 In Situ Remediation Confined Sediment Treatment Facility		Option E1 Excavation Separation, Treatment Backfill		Option E2 Excavation Off site Disposal New Backfill		Option E3 Excavation Off site Disposal No Backfill	
Evaluation Criteria	*Rating	**Score	*Rating	**Score	*Rating	**Score	*Rating	**Score	*Rating	**Score	*Rating	**Score	*Rating	**Score	*Rating	**Score	*Rating	**Score
Technical Feasibility																		
Long Term Effectiveness	very poor rating	10	poor rating	8	medium rating	6	medium rating	6	good rating	4	good rating	4	very good rating	2	very good rating	2	very good rating	2
Short Term Effectiveness	very poor rating	10	poor rating	8	very good rating	2	very good rating	2	good rating	4	medium rating	6	medium rating	6	medium rating	6	medium rating	6
Implementability	very poor rating	10	very poor rating	10	medium rating	6	medium rating	6	good rating	4	good rating	4	good rating	4	medium rating	6	poor rating	8
Restoration Time Frame ("poor rating" for relatively long, "high rating" for relatively short)	very poor rating	10	very poor rating	10	poor rating	8	poor rating	8	good rating	4	good rating	4	very good rating	2	very good rating	2	very good rating	2
Economic Feasibility																		
Projected Initial Capital Costs	$0		$4,000,000		$25,000,000		$21,000,000		$37,000,000		$48,000,000		$89,000,000		$85,000,000		$76,000,000	
Projected Annual Operation, Maintenance and Monitoring (OMM) Costs	$0		$31,000		$140,000		$140,000		$140,000		$140,000		$260,000		$260,000		$140,000	
Annualized Total Costs (40 years, i=5%)	$0		$250,000		$1,600,000		$1,400,000		$2,300,000		$2,900,000		$5,400,000		$5,200,000		$4,600,000	
Capitalized Total Costs: (40 years, i=5%)	$0	1	$4,300,000	1	$28,000,000	3	$24,000,000	3	$40,000,000	4	$51,000,000	5	$93,000,000	9	$89,000,000	9	$79,000,000	8
Potential Future Liability	very high relative liability	10	very high relative liability	10	medium relative liability	6	medium relative liability	6	low relative liability	4	low relative liability	4	very low relative liability	2	low relative liability	4	low relative liability	4
***Total Score:		51		47		31		31		24		27		25		29		30

Options presented only pertain to the area within site limits below:
South limit = northern boundary of railroad right of way
North limit = south to 2900N gridline in Chequamegon Bay
West limit = east edge of Ellis Avenue
East limit = west edge of Prentice Avenue

*** Rating System**
Ratings for specific evaluation criteria take into account several factors as required in WAC NR722.07(4)
Ratings are preliminary and may be revised based upon results of further data collection, pilot studies, and modelling.

****Scoring System:**
1 = best rating for specific evaluation criteria, 10 = worst rating for specific evaluation criteria.

*****The lowest total score is considered the best score, and therefore may be the best option.**
6 is lowest possible total score. 60 is highest possible total score.

Appendix A

Analytical Results

EN CHEM INC.

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800-7-ENCHEM
FAX: 920-469-8827

- Analytical Report -

Project Name : ASHLAND LAKEFRONT

Project Number : WIDNR9401.02

Client: SEH

WI DNR LAB ID : 405132750

Report Date : 3/13/98

Sample No.	Field ID	Collection Date	Sample No.	Field ID	Collection Date
881041-001	KREHER PARK COMPOSITE	2/23/98			
881041-002	SEDIMENT COMPOSITE	2/23/98			
881041-003	SD-9 2400N, 1400E (0-2')	2/23/98			

The "Q" flag is present when a parameter has been detected below the LOQ. This indicates the results are qualified due to the uncertainty of the parameter concentration between the LOD and the LOQ.

Soil VOC detects are corrected for the total solids, unless otherwise noted.

I certify that the data contained in this Final Report has been generated and reviewed in accordance with approved methods and Laboratory Standard Operating Procedure. Exceptions, if any, are discussed in the accompanying sample narrative. Release of this final report is authorized by Laboratory management, as is verified by the following signature.

J. Duranceau
Approval Signature

3/13/98
Date

EN CHEM INC.

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FAX: 920-469-8827

Lab#:	TestGroupID:	Comment:
881041-002 SEDIMENT COMPOSITE	8260+-S-ME	Sample exhibits hydrocarbon pattern resembling gasoline. Early and late peaks were present.

ENCHEM INC.
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FAX: 920-469-8827

- Analytical Report -

Project Name : ASHLAND LAKEFRONT
Project Number : WIDNR9401.02
Field ID : KREHER PARK COMPOSITE
Lab Sample Number : 881041-001
WI DNR LAB ID : 405132750

Client : SEH
Report Date : 3/11/98
Collection Date : 2/23/98
Matrix Type : SOIL

Inorganic Results

Test		Result	LOD	LOQ	EQL	Units	Code	Analysis Date	Prep Method	Analysis Method	Analyst
Arsenic		3.3	0.89	2.8		mg/kg		3/2/98	SW846 3051	SW846 6010B	MAD
Arsenic - TCLP	<	0.70			0.70	mg/L		3/3/98	SW846 3010A	SW846 6010B	MAD
Cadmium		0.43	0.070	0.22		mg/kg		3/2/98	SW846 3051	SW846 6010B	MAD
Chromium		4.8	0.12	0.38		mg/kg		3/2/98	SW846 3051	SW846 6010B	MAD
Copper		14	0.21	0.67		mg/kg		3/2/98	SW846 3051	SW846 6010B	MAD
Lead		52	0.47	1.5		mg/kg		3/2/98	SW846 3051	SW846 6010B	MAD
Lead - TCLP	<	0.20			0.20	mg/L		3/3/98	SW846 3010A	SW846 6010B	MAD
Nickel		4.8	0.76	2.4		mg/kg		3/2/98	SW846 3051	SW846 6010B	MAD
Zinc		72	0.74	2.4		mg/kg		3/2/98	SW846 3051	SW846 6010B	MAD
Solids, percent		47.2				%		2/27/98	SM2540G	SM2540G	NJS

Organic Results

BENZENE - TCLP **Prep Method:** SW846 5030 **Prep Date:** **Analyst:** MAD

Analyte		Result	LOD	LOQ	EQL	Units	Code	Analysis Date	Analysis Method
Toluene-d8		94			1.0	%Recov		3/3/98	SW846 8260
Dibromofluoromethane		99			1.0	%Recov		3/3/98	SW846 8260
4-Bromofluorobenzene		106			1.0	%Recov		3/3/98	SW846 8260
Benzene		0.38			0.10	mg/L		3/3/98	SW846 8260

Organic Results

EPA 8260 VOLATILE LIST - SOIL/METHANOL **Prep Method:** SW846 5030 **Prep Date:** 2/27/98 **Analyst:** RJN

Analyte		Result	LOD	LOQ	EQL	Units	Code	Analysis Date	Analysis Method
Benzene		8300	2600	6200		ug/kg		3/2/98	SW846 8260
Bromobenzene	<	1300	1300	3100		ug/kg		3/2/98	SW846 8260
Bromochloromethane	<	1300	1300	3100		ug/kg		3/2/98	SW846 8260

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EN CHEM INC.

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- Analytical Report -

Project Name : ASHLAND LAKEFRONT

Project Number : WIDNR9401.02 **Client :** SEH

Field ID : KREHER PARK COMPOSITE **Report Date :** 3/11/98

Lab Sample Number : 881041-001 **Collection Date :** 2/23/98

WI DNR LAB ID : 405132750 **Matrix Type :** SOIL

Bromodichloromethane	<	1300	1300	3100	ug/kg	3/2/98	SW846 8260
Bromoform	<	1300	1300	3100	ug/kg	3/2/98	SW846 8260
Bromomethane	<	1300	1300	3100	ug/kg	3/2/98	SW846 8260
s-Butylbenzene	<	1300	1300	3100	ug/kg	3/2/98	SW846 8260
t-Butylbenzene	<	1300	1300	3100	ug/kg	3/2/98	SW846 8260
n-Butylbenzene	<	1300	1300	3100	ug/kg	3/2/98	SW846 8260
Carbon tetrachloride	<	1300	1300	3100	ug/kg	3/2/98	SW846 8260
Chloroform	<	1300	1300	3100	ug/kg	3/2/98	SW846 8260
Chlorobenzene	<	1300	1300	3100	ug/kg	3/2/98	SW846 8260
Chlorodibromomethane	<	1300	1300	3100	ug/kg	3/2/98	SW846 8260
Chloroethane	<	1300	1300	3100	ug/kg	3/2/98	SW846 8260
Chloromethane	<	1300	1300	3100	ug/kg	3/2/98	SW846 8260
2-Chlorotoluene	<	1300	1300	3100	ug/kg	3/2/98	SW846 8260
4-Chlorotoluene	<	1300	1300	3100	ug/kg	3/2/98	SW846 8260
1,2-Dibromo-3-chloropropane	<	1300	1300	3100	ug/kg	3/2/98	SW846 8260
1,2-Dibromoethane	<	1300	1300	3100	ug/kg	3/2/98	SW846 8260
Dibromomethane	<	1300	1300	3100	ug/kg	3/2/98	SW846 8260
1,3-Dichlorobenzene	<	1300	1300	3100	ug/kg	3/2/98	SW846 8260
1,4-Dichlorobenzene	<	1300	1300	3100	ug/kg	3/2/98	SW846 8260
1,2-Dichloroethane	<	1300	1300	3100	ug/kg	3/2/98	SW846 8260
1,2-Dichlorobenzene	<	1300	1300	3100	ug/kg	3/2/98	SW846 8260
1,1-Dichloroethene	<	1300	1300	3100	ug/kg	3/2/98	SW846 8260
cis-1,2-Dichloroethene	<	1300	1300	3100	ug/kg	3/2/98	SW846 8260
Dichlorodifluoromethane	<	1300	1300	3100	ug/kg	3/2/98	SW846 8260
trans-1,2-Dichloroethene	<	1300	1300	3100	ug/kg	3/2/98	SW846 8260
1,2-Dichloropropane	<	1300	1300	3100	ug/kg	3/2/98	SW846 8260
1,1-Dichloroethane	<	1300	1300	3100	ug/kg	3/2/98	SW846 8260
1,3-Dichloropropane	<	1300	1300	3100	ug/kg	3/2/98	SW846 8260
2,2-Dichloropropane	<	1300	1300	3100	ug/kg	3/2/98	SW846 8260
1,1-Dichloropropene	<	1300	1300	3100	ug/kg	3/2/98	SW846 8260
cis-1,3-Dichloropropene	<	1300	1300	3100	ug/kg	3/2/98	SW846 8260
trans-1,3-Dichloropropene	<	1300	1300	3100	ug/kg	3/2/98	SW846 8260
Diisopropyl ether	<	1300	1300	3100	ug/kg	3/2/98	SW846 8260
Ethylbenzene		35000	2600	6200	ug/kg	3/2/98	SW846 8260
Fluorotrichloromethane	<	1300	1300	3100	ug/kg	3/2/98	SW846 8260

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EN CHEM INC.

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FAX: 920-469-8827

- Analytical Report -

Project Name : ASHLAND LAKEFRONT

Project Number : WIDNR9401.02 — Client : SEH

Field ID : KREHER PARK COMPOSITE — Report Date : 3/11/98

Lab Sample Number : 881041-001 — Collection Date : 2/23/98

WI DNR LAB ID : 405132750 — Matrix Type : SOIL

Hexachlorobutadiene	<	1300	1300	3100	ug/kg		3/2/98	SW846 8260
Isopropylbenzene		4200	2600	6200	ug/kg	Q	3/2/98	SW846 8260
p-Isopropyltoluene		4400	2600	6200	ug/kg	Q	3/2/98	SW846 8260
Methylene chloride	<	1300	1300	3100	ug/kg		3/2/98	SW846 8260
Methyl-tert-butyl-ether	<	1300	1300	3100	ug/kg		3/2/98	SW846 8260
Naphthalene		470000	2600	6200	ug/kg		3/2/98	SW846 8260
n-Propylbenzene	<	1300	1300	3100	ug/kg		3/2/98	SW846 8260
Styrene	<	1300	1300	3100	ug/kg		3/2/98	SW846 8260
1,1,2,2-Tetrachloroethane	<	1300	1300	3100	ug/kg		3/2/98	SW846 8260
1,1,1,2-Tetrachloroethane	<	1300	1300	3100	ug/kg		3/2/98	SW846 8260
Tetrachloroethene	<	1300	1300	3100	ug/kg		3/2/98	SW846 8260
Toluene		16000	2600	6200	ug/kg		3/2/98	SW846 8260
1,2,3-Trichlorobenzene	<	1300	1300	3100	ug/kg		3/2/98	SW846 8260
1,2,4-Trichlorobenzene	<	1300	1300	3100	ug/kg		3/2/98	SW846 8260
1,1,1-Trichloroethane	<	1300	1300	3100	ug/kg		3/2/98	SW846 8260
1,1,2-Trichloroethane	<	1300	1300	3100	ug/kg		3/2/98	SW846 8260
1,2,4-Trimethylbenzene		28000	2600	6200	ug/kg		3/2/98	SW846 8260
Trichloroethene	<	1300	1300	3100	ug/kg		3/2/98	SW846 8260
1,2,3-Trichloropropane	<	1300	1300	3100	ug/kg		3/2/98	SW846 8260
1,3,5-Trimethylbenzene		7900	2600	6200	ug/kg		3/2/98	SW846 8260
Vinyl chloride	<	1300	1300	3100	ug/kg		3/2/98	SW846 8260
Xylenes, -m, -p		36000	2600	6200	ug/kg		3/2/98	SW846 8260
Xylene, -o		17000	2600	6200	ug/kg		3/2/98	SW846 8260
4-Bromofluorobenzene		78			%Recov		3/2/98	SW846 8260
Dibromofluoromethane		74			%Recov		3/2/98	SW846 8260
Toluene-d8		73			%Recov		3/2/98	SW846 8260

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- Analytical Report -

Project Name : ASHLAND LAKEFRONT

Project Number : WIDNR9401.02 **Client :** SEH

Field ID : SEDIMENT COMPOSITE **Report Date :** 3/12/98

Lab Sample Number : 881041-002 **Collection Date :** 2/23/98

WI DNR LAB ID : 405132750 **Matrix Type :** SOIL

Inorganic Results

Test	Result	LOD	LOQ	EQL	Units	Code	Analysis Date	Prep Method	Analysis Method	Analyst
Arsenic	1.3	0.63	2.0		mg/kg	Q	3/2/98	SW846 3051	SW846 6010B	MAD
Arsenic - TCLP	< 0.70			0.70	mg/L		3/3/98	SW846 3010A	SW846 6010B	MAD
Cadmium	0.058	0.049	0.16		mg/kg	Q	3/2/98	SW846 3051	SW846 6010B	MAD
Chromium	4.2	0.087	0.28		mg/kg		3/2/98	SW846 3051	SW846 6010B	MAD
Copper	7.0	0.15	0.48		mg/kg		3/2/98	SW846 3051	SW846 6010B	MAD
Lead	4.6	0.33	1.1		mg/kg		3/2/98	SW846 3051	SW846 6010B	MAD
Lead - TCLP	< 0.20			0.20	mg/L		3/3/98	SW846 3010A	SW846 6010B	MAD
Nickel	3.6	0.54	1.7		mg/kg		3/2/98	SW846 3051	SW846 6010B	MAD
TOC as NPOC	29000	17	54		mg/kg		2/27/98	SW846 9060M	SW846 9060M	sub
Zinc	14	0.52	1.7		mg/kg		3/2/98	SW846 3051	SW846 6010B	MAD
Solids, percent	66.7				%		2/27/98	SM2540G	SM2540G	NJS

Organic Results

BENZENE - TCLP **Prep Method:** SW846 5030 **Prep Date:** **Analyst:** MAD

Analyte	Result	LOD	LOQ	EQL	Units	Code	Analysis Date	Analysis Method
Dibromofluoromethane	99			1.0	%Recov		3/3/98	SW846 8260
4-Bromofluorobenzene	116			1.0	%Recov		3/3/98	SW846 8260
Toluene-d8	103			1.0	%Recov		3/3/98	SW846 8260
Benzene	< 0.10			0.10	mg/L		3/3/98	SW846 8260

Organic Results

EPA 8260 VOLATILE LIST - SOIL/METHANOL **Prep Method:** SW846 5030 **Prep Date:** 2/27/98 **Analyst:** RJN

Analyte	Result	LOD	LOQ	EQL	Units	Code	Analysis Date	Analysis Method
Benzene	2400	750	1800		ug/kg		3/3/98	SW846 8260
Bromobenzene	< 500	500	1200		ug/kg		3/3/98	SW846 8260

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- Analytical Report -

Project Name : ASHLAND LAKEFRONT

Project Number : WIDNR9401.02

Client : SEH

Field ID : SEDIMENT COMPOSITE

Report Date : 3/12/98

Lab Sample Number : 881041-002

Collection Date : 2/23/98

WI DNR LAB ID : 405132750

Matrix Type : SOIL

Bromochloromethane	<	500	500	1200	ug/kg	3/3/98	SW846 8260
Bromodichloromethane	<	500	500	1200	ug/kg	3/3/98	SW846 8260
Bromoform	<	500	500	1200	ug/kg	3/3/98	SW846 8260
Bromomethane	<	500	500	1200	ug/kg	3/3/98	SW846 8260
s-Butylbenzene		1900	750	1800	ug/kg	3/3/98	SW846 8260
t-Butylbenzene	<	500	500	1200	ug/kg	3/3/98	SW846 8260
n-Butylbenzene		5200	750	1800	ug/kg	3/3/98	SW846 8260
Carbon tetrachloride	<	500	500	1200	ug/kg	3/3/98	SW846 8260
Chloroform	<	500	500	1200	ug/kg	3/3/98	SW846 8260
Chlorobenzene	<	500	500	1200	ug/kg	3/3/98	SW846 8260
Chlorodibromomethane	<	500	500	1200	ug/kg	3/3/98	SW846 8260
Chloroethane	<	500	500	1200	ug/kg	3/3/98	SW846 8260
Chloromethane	<	500	500	1200	ug/kg	3/3/98	SW846 8260
2-Chlorotoluene	<	500	500	1200	ug/kg	3/3/98	SW846 8260
4-Chlorotoluene	<	500	500	1200	ug/kg	3/3/98	SW846 8260
1,2-Dibromo-3-chloropropane	<	500	500	1200	ug/kg	3/3/98	SW846 8260
1,2-Dibromoethane	<	500	500	1200	ug/kg	3/3/98	SW846 8260
Dibromomethane	<	500	500	1200	ug/kg	3/3/98	SW846 8260
1,3-Dichlorobenzene	<	500	500	1200	ug/kg	3/3/98	SW846 8260
1,4-Dichlorobenzene	<	500	500	1200	ug/kg	3/3/98	SW846 8260
1,2-Dichloroethane	<	500	500	1200	ug/kg	3/3/98	SW846 8260
1,2-Dichlorobenzene	<	500	500	1200	ug/kg	3/3/98	SW846 8260
1,1-Dichloroethene	<	500	500	1200	ug/kg	3/3/98	SW846 8260
cis-1,2-Dichloroethene	<	500	500	1200	ug/kg	3/3/98	SW846 8260
Dichlorodifluoromethane	<	500	500	1200	ug/kg	3/3/98	SW846 8260
trans-1,2-Dichloroethene	<	500	500	1200	ug/kg	3/3/98	SW846 8260
1,2-Dichloropropane	<	500	500	1200	ug/kg	3/3/98	SW846 8260
1,1-Dichloroethane	<	500	500	1200	ug/kg	3/3/98	SW846 8260
1,3-Dichloropropane	<	500	500	1200	ug/kg	3/3/98	SW846 8260
2,2-Dichloropropane	<	500	500	1200	ug/kg	3/3/98	SW846 8260
1,1-Dichloropropene	<	500	500	1200	ug/kg	3/3/98	SW846 8260
cis-1,3-Dichloropropene	<	500	500	1200	ug/kg	3/3/98	SW846 8260
trans-1,3-Dichloropropene	<	500	500	1200	ug/kg	3/3/98	SW846 8260
Diisopropyl ether	<	500	500	1200	ug/kg	3/3/98	SW846 8260
Ethylbenzene		18000	750	1800	ug/kg	3/3/98	SW846 8260

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EN CHEM INC.

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- Analytical Report -

Project Name : ASHLAND LAKEFRONT

Project Number : WIDNR9401.02 **Client :** SEH

Field ID : SEDIMENT COMPOSITE **Report Date :** 3/12/98

Lab Sample Number : 881041-002 **Collection Date :** 2/23/98

WI DNR LAB ID : 405132750 **Matrix Type :** SOIL

Fluorotrichloromethane	< 500	500	1200		ug/kg		3/3/98	SW846 8260
Hexachlorobutadiene	< 500	500	1200		ug/kg		3/3/98	SW846 8260
Isopropylbenzene	2000	750	1800		ug/kg		3/3/98	SW846 8260
p-Isopropyltoluene	1900	750	1800		ug/kg		3/3/98	SW846 8260
Methylene chloride	< 500	500	1200		ug/kg		3/3/98	SW846 8260
Methyl-tert-butyl-ether	< 500	500	1200		ug/kg		3/3/98	SW846 8260
Naphthalene	230000	750	1800		ug/kg		3/3/98	SW846 8260
n-Propylbenzene	1300	750	1800		ug/kg	Q	3/3/98	SW846 8260
Styrene	< 500	500	1200		ug/kg		3/3/98	SW846 8260
1,1,2,2-Tetrachloroethane	< 500	500	1200		ug/kg		3/3/98	SW846 8260
1,1,1,2-Tetrachloroethane	< 500	500	1200		ug/kg		3/3/98	SW846 8260
Tetrachloroethene	< 500	500	1200		ug/kg		3/3/98	SW846 8260
Toluene	5900	750	1800		ug/kg		3/3/98	SW846 8260
1,2,3-Trichlorobenzene	< 500	500	1200		ug/kg		3/3/98	SW846 8260
1,2,4-Trichlorobenzene	< 500	500	1200		ug/kg		3/3/98	SW846 8260
1,1,1-Trichloroethane	< 500	500	1200		ug/kg		3/3/98	SW846 8260
1,1,2-Trichloroethane	< 500	500	1200		ug/kg		3/3/98	SW846 8260
1,2,4-Trimethylbenzene	9400	750	1800		ug/kg		3/3/98	SW846 8260
Trichloroethene	< 500	500	1200		ug/kg		3/3/98	SW846 8260
1,2,3-Trichloropropane	< 500	500	1200		ug/kg		3/3/98	SW846 8260
1,3,5-Trimethylbenzene	2800	750	1800		ug/kg		3/3/98	SW846 8260
Vinyl chloride	< 500	500	1200		ug/kg		3/3/98	SW846 8260
Xylenes, -m, -p	11000	750	1800		ug/kg		3/3/98	SW846 8260
Xylene, -o	5600	750	1800		ug/kg		3/3/98	SW846 8260
4-Bromofluorobenzene	91				%Recov		3/3/98	SW846 8260
Dibromofluoromethane	74				%Recov		3/3/98	SW846 8260
Toluene-d8	94				%Recov		3/3/98	SW846 8260

Organic Results

PAH - WI LUST LIST - SEMIVOLATILES **Prep Method:** SW846 3550 **Prep Date:** 3/3/98 **Analyst:** NJS

Analyte	Result	LOD	LOQ	EQL	Units	Code	Analysis Date	Analysis Method
Acenaphthene	68000	1900	6100		ug/kg		3/4/98	SW846 8270
Acenaphthylene	< 2100	2100	6700		ug/kg		3/4/98	SW846 8270

All soil results are reported on a dry weight basis unless otherwise noted.

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- Analytical Report -

Project Name : ASHLAND LAKEFRONT

Project Number : WIDNR9401.02 **Client :** SEH

Field ID : SEDIMENT COMPOSITE **Report Date :** 3/12/98

Lab Sample Number : 881041-002 **Collection Date :** 2/23/98

WI DNR LAB ID : 405132750 **Matrix Type :** SOIL

Anthracene		30000	1800	5700	ug/kg		3/4/98	SW846 8270
Benzo(a)anthracene		14000	1700	5400	ug/kg		3/4/98	SW846 8270
Benzo(a)pyrene		13000	1600	5100	ug/kg		3/4/98	SW846 8270
Benzo(b)fluoranthene		6500	2000	6400	ug/kg		3/4/98	SW846 8270
Benzo(g,h,i)perylene		4500	1900	6100	ug/kg	Q	3/4/98	SW846 8270
Benzo(k)fluoranthene		6600	1900	6100	ug/kg		3/4/98	SW846 8270
Chrysene		12000	1800	5700	ug/kg		3/4/98	SW846 8270
Dibenzo(a,h)anthracene	<	2800	2800	8900	ug/kg		3/4/98	SW846 8270
Fluoranthene		28000	1900	6100	ug/kg		3/4/98	SW846 8270
Fluorene		27000	2300	7300	ug/kg		3/4/98	SW846 8270
Indeno(1,2,3-cd)pyrene		4600	1900	6100	ug/kg	Q	3/4/98	SW846 8270
1-Methylnaphthalene		68000	2300	7300	ug/kg		3/4/98	SW846 8270
2-Methylnaphthalene		100000	2200	7000	ug/kg		3/4/98	SW846 8270
Naphthalene		170000	2000	6400	ug/kg		3/4/98	SW846 8270
Phenanthrene		79000	2100	6700	ug/kg		3/4/98	SW846 8270
Pyrene		41000	1900	6100	ug/kg		3/4/98	SW846 8270
Nitrobenzene-d5		103			%Recov		3/4/98	SW846 8270
2-Fluorobiphenyl		107			%Recov		3/4/98	SW846 8270
Terphenyl-d14		100			%Recov		3/4/98	SW846 8270

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- Analytical Report -

Project Name : ASHLAND LAKEFRONT

Project Number : WIDNR9401.02

Client : SEH

Field ID : SEEP(1'-2') SOIL

Report Date : 3/13/98

Lab Sample Number : 881012-001

Collection Date : 2/23/98

WI DNR LAB ID : 405132750

Matrix Type : SOIL

Inorganic Results

Test	Result	LOD	LOQ	EQL	Units	Code	Analysis Date	Prep Method	Analysis Method	Analyst
Arsenic	5.3	0.33	1.1		mg/kg		3/3/98	SW846 3050B	SW846 6010B	MAD
Arsenic - TCLP	< 0.70			0.70	mg/L		3/3/98	SW846 3010A	SW846 6010B	MAD
Barium	77	0.077	0.25		mg/kg		3/3/98	SW846 3050B	SW846 6010B	MAD
Cadmium	2.2	0.066	0.21		mg/kg		3/3/98	SW846 3050B	SW846 6010B	MAD
Chromium	8.5	0.19	0.61		mg/kg		3/3/98	SW846 3050B	SW846 6010B	MAD
Lead	68	0.22	0.70		mg/kg		3/3/98	SW846 3050B	SW846 6010B	MAD
Lead - TCLP	< 0.20			0.20	mg/L		3/3/98	SW846 3010A	SW846 6010B	MAD
Mercury	0.063	0.063	0.20		mg/kg	Q	3/6/98	SW846 7471A	SW846 7471A	MAD
Selenium	1.7	0.36	1.1		mg/kg		3/3/98	SW846 3050B	SW846 6010B	MAD
Silver	0.54	0.31	0.99		mg/kg	Q	3/3/98	SW846 3050B	SW846 6010B	MAD
Solids, percent	63.9				%		3/3/98	SM 2540G	SM 2540G	MAD
Zinc	810	0.55	1.8		mg/kg		3/3/98	SW846 3050B	SW846 6010B	MAD

Organic Results

BENZENE - TCLP **Prep Method:** SW846 5030 **Prep Date:** **Analyst:** MAD

Analyte	Result	LOD	LOQ	EQL	Units	Code	Analysis Date	Analysis Method
Toluene-d8	106			1.0	%Recov		3/3/98	SW846 8260
Dibromofluoromethane	108			1.0	%Recov		3/3/98	SW846 8260
4-Bromofluorobenzene	97			1.0	%Recov		3/3/98	SW846 8260
Benzene	< 0.10			0.10	mg/L		3/3/98	SW846 8260

All soil results are reported on a dry weight basis unless otherwise noted.

EN CHEM INC.

1795 Industrial Drive
Green Bay, WI 54302
920-469-2436
800-7-ENCHEM
FAX: 920-469-8827

- Analytical Report -

Project Name :	ASHLAND LAKEFRONT		
Project Number :	WIDNR9401.02	Client :	SEH
Field ID :	SD-9 2400N, 1400E (0-2')	Report Date :	3/11/98
Lab Sample Number :	881041-003	Collection Date :	2/23/98
WI DNR LAB ID :	405132750	Matrix Type :	SOIL

Inorganic Results

Test		Result	LOD	LOQ	EQL	Units	Code	Analysis Date	Prep Method	Analysis Method	Analyst
Arsenic		1.0	0.60	1.9		mg/kg	Q	3/2/98	SW846 3051	SW846 6010B	MAD
Arsenic - TCLP	<	0.70			0.70	mg/L		3/3/98	SW846 3010A	SW846 6010B	MAD
Cadmium	<	0.047	0.047	0.15		mg/kg		3/2/98	SW846 3051	SW846 6010B	MAD
Chromium		5.4	0.083	0.26		mg/kg		3/2/98	SW846 3051	SW846 6010B	MAD
Copper		5.1	0.14	0.45		mg/kg		3/2/98	SW846 3051	SW846 6010B	MAD
Lead		2.6	0.32	1.0		mg/kg		3/2/98	SW846 3051	SW846 6010B	MAD
Lead - TCLP	<	0.20			0.20	mg/L		3/3/98	SW846 3010A	SW846 6010B	MAD
Nickel		4.0	0.52	1.7		mg/kg		3/2/98	SW846 3051	SW846 6010B	MAD
Zinc		35	0.50	1.6		mg/kg		3/2/98	SW846 3051	SW846 6010B	MAD
Solids, percent		69.8				%		2/27/98	SM2540G	SM2540G	NJS

Organic Results

BENZENE - TCLP — **Prep Method:** SW846 5030 — **Prep Date:** — **Analyst:** MAD

Analyte	Result	LOD	LOQ	EQL	Units	Code	Analysis Date	Analysis Method
Toluene-d8	92			1.0	%Recov		3/3/98	SW846 8260
Dibromofluoromethane	100			1.0	%Recov		3/3/98	SW846 8260
4-Bromofluorobenzene	100			1.0	%Recov		3/3/98	SW846 8260
Benzene	0.24			0.10	mg/L		3/3/98	SW846 8260

All soil results are reported on a dry weight basis unless otherwise noted.

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☐ 802 Deming Way, Madison, WI 53717, 608-827-5501 • 1-888-536-2436, Fax: 608-827-5503

☐ 1423 N. 8th Street., Suite 122, Superior, WI 54880, 715-392-5844 • 1-800-837-8238, FAX 715-392-5843

v/ $^{0}/_{1}$

CHAIN OF CUSTODY

17365

Company Name: SEH, Inc.
Branch or Location: Chippewa Falls, WI
Project Contact: Jim Thornton
Telephone: (715) 720-6226
Project Number: WIDNR9401.02
Project Name: ASHLAND LAKEFRONT
Project Location: ASHLAND, WI
Sampled By (Print): JIM THORNTON / MARK BROSES

Regulatory Program (circle): UST RCRA CLP SDWA NPDES/WPDES CAA NR____ Other ____

NR720 Confirmation Analysis Required? (circle): Y N
(En Chem will not confirm unless otherwise instructed.)

Page 1 of 1
P.O. # ____ Quote # ____
Mail Report To: JIM THORNTON
Company: SEH
Address: 421 FRENETTE DRIVE, CHIPPEWA FALLS, WI 54729
Invoice To: SEH ATTN: MARK BROSES
Company:
Address: AS ABOVE
Mail Invoice To:

ANALYSES REQUESTED

					TCLP-Lead, Arsenic	TCLP-Benzene	PAH	VOC	TOC*	Total Metals								
				FILTERED? (YES/NO)	N	N	N	N	N	N								
				PRESERVATION (CODE)*	A	A	A	F	A	A								
FIELD ID	SAMPLE DESCRIPTION	COLLECTION DATE	COLLECTION TIME										FIELD SCREEN	MATRIX	GOOD COND.	TOTAL BOTTLES	COMMENTS	LABORATORY NUMBER
	KREHER PARK COMPOSITE	2/23/98			✓	✓		✓		✓			N/A	SOIL	✓	1-2oz-M, 2-2oz ZHE, 1-5oz, 1-8oz Amber		001
	SEDIMENT COMPOSITE	↓			✓	✓	✓	✓	✓	✓				SED	✓	1-2oz-M, 2-2oz ZHE, 2-8oz Amber		002
SD-9	2400N, 1400E (0-2')	↓			✓	✓				✓			↓	↓	✓	2-2oz ZHE, 1-8oz Amber		003

SHADED AREA FOR LABORATORY USE ONLY

* Please "rush" TOC results & fax to SEH when available @ 715-720-6300
Thanks

no meoh blank supplied 2/26/98 CD

*Preservation Code
A=None B=HCL C=H2SO4
D=HN03 E=EnCore F=Methanol**
G=NaOH O=Other (Indicate)

**If not using En Chem's methanol, indicate volume of methanol added and mark the appropriate samples.

Relinquished By:	Date/Time:	Received By:	Date/Time:
James J. Thornton	2/25/98 12:50		
Dunham		Received By (En Chem): [signature]	3/26/98 1030

En Chem Project No.: 881041
Sample Receipt Temp.: ROI
Sample Receipt pH (Wet/Metals):

EN CHEM INC.

1795 Industrial Drive
Green Bay, WI 54302
920-469-2436
800-7-ENCHEM
FAX: 920-469-8827

- Analytical Report -

Project Name : ASHLAND LAKEFRONT

Project Number : WIDNR9401.02

Client: SEH

WI DNR LAB ID : 405132750

Report Date : 3/13/98

Sample No.	Field ID	Collection Date	Sample No.	Field ID	Collection Date
881012-001	SEEP(1'-2') SOIL	2/23/98			

The "Q" flag is present when a parameter has been detected below the LOQ. This indicates the results are qualified due to the uncertainty of the parameter concentration between the LOD and the LOQ.

Soil VOC detects are corrected for the total solids, unless otherwise noted.

I certify that the data contained in this Final Report has been generated and reviewed in accordance with approved methods and Laboratory Standard Operating Procedure. Exceptions, if any, are discussed in the accompanying sample narrative. Release of this final report is authorized by Laboratory management, as is verified by the following signature.

Q. Durancau
Approval Signature

3/13/98
Date

02/25/98 WED 11:27 FAX 715 720 6300 SEH CHIPPEWA 002

EN CHEM INC.

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☐ 1423 N. 8th Street, Suite 122, Superior, WI 54880, 715-392-5844 • 1-800-837-8238, FAX 715-392-5843

CHAIN OF CUSTODY

20768

Page 1 of 1
P.O. # ______ Quote # ______

Company Name: SEH, Inc.
Branch or Location: Chippewa Falls
Project Contact: JIM THORNTON
Telephone: (715) 720-6226
Project Number: WIDNR9401.02
Project Name: ASHLAND LAKEFRONT
Project Location: ASHLAND, WI
Sampled By (Print): MARK BROSES/JAMES THORNTON
Regulatory Program (circle): UST RCRA CLP SDWA NPDES/WPDES CAA NR____ Other ____
NR720 Confirmation Analysis Required? (circle): Y (N)
(En Chem will not confirm unless otherwise instructed.)

Mail Report To: JIM THORNTON
Company: SEH
Address: 921 FRENETTE DRIVE, CHIPPEWA FALLS, WI 54729
Invoice To: MARK BROSES
Company: SEH
Address: SAME AS ABOVE
Mail Invoice To: MARK BROSES @ SEH

FILTERED? (YES/NO)
PRESERVATION (CODE)*

ANALYSES REQUESTED: PRIORITY 1 2 3 4
TCLP BENZENE
TCLP ARSENIC
TCLP LEAD
METALS (As, Pb, Zn, etc.)
"etc." means RCRA metals per James Thornton. MAR

SHADED AREA FOR LABORATORY USE ONLY

FIELD ID	SAMPLE DESCRIPTION	COLLECTION DATE	COLLECTION TIME	TCLP BENZENE	TCLP ARSENIC	TCLP LEAD	METALS				FIELD SCREEN	MATRIX	GOOD COND.	TOTAL BOTTLES	COMMENTS	LABORATORY NUMBER
	SEEP (1'-2') SOIL	2/23/98		✓	✓	✓	✓				NA	SOIL		1-8oz	Amber	001

*Preservation Code
A=None B=HCL C=H2SO4
D=HN03 E=EnCore F=Methanol**
G=NaOH O=Other (indicate)

**If not using En Chem's methanol, indicate volume of methanol added and mark the appropriate samples.

Relinquished By:	Date/Time:	Received By:	Date/Time:
JAMES THORNTON	2/23/98 13:00		
[illegible]		[illegible]	2/25/98 0935

En Chem Project No.: 881012
Sample Receipt Temp.: ROI
Sample Receipt pH (Wet/Metals):

Appendix B

Waste Quantity Calculations

Estimate of Waste Quantities for Ashland Lakefront Property and Contaminated Sediments

Description	Area (sft)	Average Thickness (ft)	Total Volume (cft)	Estimated Porosity	Volume of Water (cft)	Wood Fraction	Volume of Wood (cft)	Dry Density of Wood (lbs/cft)	Dry Mass of Wood (lbs)	Volume of Fill, Soil or Sediment (cft)	Dry Density of Fill,Soil or Seds (lbs/cft)	Mass of Dry Fill, Soil or Seds (lbs)	Total Dry Mass Wood, Fill Soil, Seds (lbs)
Vadose Zone - Adsorbed													
Contam. Seep Area Vadose Zone	2,500	1	2,500	0.3	0	0.05	125	50	6,250	2,375	100	237,500	243,750
Very Contaminated Vadose Zone	15,000	3	45,000	0.3	0	0.05	2,250	50	112,500	42,750	100	4,275,000	4,387,500
Medium Contaminated Vadose Zone	100,000	4	400,000	0.3	0	0.05	20,000	50	1,000,000	380,000	100	38,000,000	39,000,000
Less Contaminated Vadose Zone	320,000	4	1,280,000	0.3	0	0.05	64,000	50	3,200,000	1,216,000	100	121,600,000	124,800,000
Subtotal:	*437,500*		*1,727,500*		*0*		*86,375*		*4,318,750*	*1,641,125*		*164,112,500*	*168,431,250*
Saturated Zone - Adsorbed and Dissolved													
Contaminated Seep Area Sat'd Zone	2,500	11	27,500	0.3	8,250	0.50	9,625	50	481,250	9,625	100	962,500	1,443,750
Very Contaminated Saturated Zone	35,000	9	315,000	0.3	94,500	0.50	110,250	50	5,512,500	110,250	100	11,025,000	16,537,500
Medium Contaminated Saturated Zone	200,000	8	1,600,000	0.3	480,000	0.50	560,000	50	28,000,000	560,000	100	56,000,000	84,000,000
Less Contaminated Saturated Zone	200,000	8	1,600,000	0.3	480,000	0.50	560,000	50	28,000,000	560,000	100	56,000,000	84,000,000
Subtotal:	*437,500*		*3,542,500*		*1,062,750*		*1,239,875*		*61,993,750*	*1,239,875*		*123,987,500*	*185,981,250*
Sediments - Adsorbed and Dissolved													
Very Contaminated Sediments (0 - 4')	410,000	4	1,640,000	0.3	492,000	0.10	114,800	50	5,740,000	1,033,200	100	103,320,000	109,060,000
Very Contaminated Sediments (4'-8')	20,000	4	80,000	0.3	24,000	0.00	0	50	0	56,000	100	5,600,000	5,600,000
Less Contaminated Sediments (4'-8')	390,000	4	1,560,000	0.3	468,000	0.00	0	50	0	1,092,000	100	109,200,000	109,200,000
Less Contaminated Sediments (8'-10')	410,000	2	820,000	0.3	246,000	0.00	0	50	0	574,000	100	57,100,000	57,400,000
Subtotal:			*4,100,000*		*1,230,000*		*114,800*		*5,740,000*	*2,755,200*		*275,520,000*	*281,260,000*
Total:			9,370,000 (cft)		2,292,750 (cft)		1,441,050 (cft)		72,052,500 (lbs)	5,636,200 (cft)		563,620,000 (lbs)	635,672,500 (lbs)
			347,037 (cy)		17,149,770 (gal)		53,372 (cy)		36,026 (tons)	208,748 (cy)		281,810 (tons)	317,836 (tons)
			Total Volume		Volume of Water		Volume of Wood		Mass of Wood	Volume of Fill, Soil or Sediment		Mass of Dry Fill, Soil or Seds	Dry Mass Wood, Fill Soil, Seds

CALCULATION OF ORIGINAL TAR VOLUME BASED ON B(a)P MASS.

Description	Avg Conc Adsorbed B(a)P (mg/kg)	Adsorbed Mass of B(a)P (lbs)	Avg Conc Dissolved B(a)P (ug/l)	Dissolved Mass of B(a)P (lbs)	Total Mass of B(a)P (lbs)	Low end Fraction B(a)P / Tar (mass/mass)	High end Fraction B(a)P / Tar (mass/mass)	Low End Original Tar Mass (lbs)	High End Original Tar Mass (lbs)	Density of Orig Tar (lb/gal)	Low End Volume of Orig Tar (gal)	High End Volume of Orig Tar (gal)
Vadose Zone - Adsorbed												
Contam. Seep Area Vadose Zone	17	4.1	0	0.0	4.1	0.0010	0.0029	1,429	4,144	8	179	518
Very Contaminated Vadose Zone	10.4	45.6	0	0.0	45.6	0.0010	0.0029	15,734	45,630	8	1,967	5,704
Medium Contaminated Vadose Zone	0.42	16.4	0	0.0	16.4	0.0010	0.0029	5,648	16,380	8	706	2,048
Less Contaminated Vadose Zone	0.12	15.0	0	0.0	15.0	0.0010	0.0029	5,164	14,976	8	646	1,872
Subtotal:		*81*		*0*	*81*						*3,497*	*10,141*
Saturated Zone - Adsorbed and Dissolved												
Contaminated Seep Area Sat'd Zone	206.0	297.4	3051	1.6	299.0	0.0010	0.0029	103,098	298,983	8	12,887	37,373
Very Contaminated Saturated Zone	55.4	916.2	301	1.8	918.0	0.0010	0.0029	316,535	917,952	8	39,567	114,744
Medium Contaminated Saturated Zone	13	1092.0	208	6.2	1098.2	0.0010	0.0029	378,700	1,098,230	8	47,338	137,279
Less Contaminated Saturated Zone	0.38	31.9	5.9	0.2	32.1	0.0010	0.0029	11,068	32,097	8	1,383	4,012
Subtotal:		*2,338*		*10*	*2,347*						*101,175*	*293,408*
Sediments - Adsorbed and Dissolved												
Very Contaminated Sediments (0 - 4')	4.2	458.1	22.8	0.7	458.8	0.0010	0.0029	158,191	458,753	8	19,774	57,344
Very Contaminated Sediments (4'-8')	37.5	210.0	203.7	0.3	210.3	0.0010	0.0029	72,519	210,305	8	9,065	26,288
Less Contaminated Sediments (4'-8')	0.52	56.8	2.8	0.1	56.9	0.0010	0.0029	19,609	56,867	8	2,451	7,108
Less Contaminated Sediments (8'-10')	0	0.0	0.0	0.0	0.0	0.0010	0.0029	0	0	8	0	0
Subtotal:		*725*		*1*	*726*						*31,290*	*90,741*
Total:		3,143 (lbs)		11 (lbs)	3,154 (lbs)						135,962 (gal)	394,290 (gal)
		Adsorbed Mass of B(a)P		Dissolved Mass of B(a)P	Total Mass of B(a)P						Low End Volume of Orig Tar	High End Volume of Orig Tar

Estimate of Residual NAPL MGP Waste Tar:

Description of area	Area (sft)	Average Thickness (ft)	Estimated Porosity	Percent NAPL occupied Pore Space	Percent NAPL occupied Pore Space	Low Estimate of Residual MGP Waste Tar (gal)	High Estimate of Residual MGP Waste Tar (gal)
Waste Tar Dump Vadose Tar	5,000	2	0.3	10.0%	50.0%	2,244	11,220
Seep Area Globules	2,500	11	0.3	2.5%	10.0%	1,543	6,171
Very Contaminated GW Globules	35,000	9	0.3	1.0%	2.5%	7,069	17,672
Medium Contaminated GW Globules	200,000	8	0.3	0.5%	1.0%	17,952	35,904
NAPL Layer in Sediments (6" - 9")	300,000	0.25	0.3	10.0%	50.0%	16,830	84,150
Total:						**45,637 gallons tar Low Estimate**	**155,117 gallons tar High Estimate**

Appendix C

Cost Projections

Feasibility Study Cost Projections
Remedial Action Option #B1: Access Restriction / Institutional Controls

Project: Ashland Lakefront - Comprehensive FS
SEH# WIDNR9401

CALC'D 'BY: MJB 18 November 1998
CHECKED BY: GPW 9 Dec 98

PRELIMINARY COST PROJECTION SUMMARY - RAO#B-1

Remedial Action Initial Capital Costs:

Enlarge Fence around Seep		$8,000	
Shoreline Fencing		$120,000	
Breakwaters		$2,250,000	
Utility Rerouting		$93,000	
Monitoring System		$16,000	
Subtotal:		$2,487,000	
Contingency	20%	$497,400	
Subtotal:		$2,984,400	
Planning and Permitting:	5%	$149,220	
Engineering	10%	$298,440	
Construction Oversight	10%	$298,440	
Subtotal, Remedial Action Initial Capital Costs:			$3,730,500
Subtotal,Initial Capital Costs:			**$3,730,500**

Long Term Operations, Maintenance, and Monitoring Costs:

Annual Site Monitoring (4 Quarters)		$19,680
Annual Site Maintenance		$5,000
Subtotal:		$24,680
Contingency	25%	$6,170
Subtotal Annual OM&M Costs:		**$30,850**

Capitalized Costs:

Long Term Operation Period, n (years)	40 years
Average Net Interest Rate, i	5%
Present Worth Factor (i, n)	17.159
Annual OM&M Costs:	$30,850
Present Worth Long Term OM&M Costs	$529,358
Initial Capital Costs:	$3,730,500
Capitalized Total Costs:	**$4,259,858**

Annualized Costs:

Long Term Operation Period, n (years)	40 years
Average Interest Rate, i	5%
Amortization Factor (i, n)	0.058
Initial Capital Costs:	$3,730,500
Amortized Capital Costs:	$217,407
Annual OM&M Costs:	$30,850
Annualized Total Costs:	**$248,257**

	quantity	unit	unit cost	subtotal
Enlarge Fence around Seep			**$**	**$**
Fencing	400	lf	20	$8,000
Subtotal:				**$8,000**

	quantity	unit	unit cost	subtotal
Shoreline Fencing			**$**	**$**
Fencing	6000	sf	20	$120,000
Subtotal:				**$120,000**

	quantity	unit	unit cost	subtotal
Breakwaters			**$**	**$**
Rubble mound Breakwater, 15' deep @2900N	1500	lf	1500	$2,250,000
Subtotal:				**$2,250,000**

	quantity	unit	unit cost	subtotal
Utility Rerouting			**$**	**$**
2nd St Storm Sewer	500	lf	80	$40,000
3d St Storm sewer	500	lf	80	$40,000
Phone	1	ls	5000	$5,000
Power	1	ls	5000	$5,000
Water Piping	1	ls	1500	$1,500
Gas	1	ls	1500	$1,500
Subtotal:				**$93,000**

	quantity	unit	unit cost	subtotal
Monitoring System			**$**	**$**
Monitoring Wells	10	ea	1000	$10,000
Oleophilic Sumps	2	ea	3000	$6,000
Subtotal:				**$16,000**

	quantity	unit	unit cost	subtotal
Annual Site Monitoring (4 Quarters)			**$**	**$**
Well development labor	96	hrs	50	$4,800
Analyses -6 monitoring points	24	samples	250	$6,000
Sampling Labor (GW samples)	48	hrs	50	$2,400
Equipment	4	days	500	$2,000
Reporting	64	hrs	70	$4,480
Subtotal:				**$19,680**

	quantity	unit	unit cost	subtotal
Annual Site Maintenance			**$**	**$**
Shoreline Erosion Control	1	ls	5000	$5,000
Subtotal:				**$5,000**

Feasibility Study Cost Projections
Remedial Action Option #C1: Confine and Fill in Contaminated Sediment Area

Project: Ashland Lakefront - Comprehensive FS
SEH# WIDNR9401

CALC'D 'BY: MJB 18 November 1998
CHECKED BY: GPW 9 Dec 98

PRELIMINARY COST PROJECTION SUMMARY - RAO#C-1

Remedial Action Initial Capital Costs:

Upgradient Cutoff Trench, Pumping, &10 gpm Treatment System		$1,237,100	
Side& Shoreline Cutoff Walls		$2,520,000	
Breakwaters		$2,250,000	
Utility Rerouting		$93,000	
Fill Lake Area		$7,322,950	
Cover park		$3,402,340	
Monitoring System		$16,000	
Subtotal:		$16,841,390	
Contingency	20%	$3,368,278	
Subtotal:		$20,209,668	
Planning and Permitting:	5%	$1,010,483	
Pilot Tests	5%	$1,010,483	
Engineering	7%	$1,414,677	
Construction Oversight	7%	$1,414,677	
Subtotal, Remedial Action Initial Capital Costs:			$25,059,988
Subtotal,Initial Capital Costs:			**$25,059,988**

Long Term Operations, Maintenance, and Monitoring Costs:

Annual GW Cutoff System O&M Costs		$64,979
Annual Remediation System Performance Monitoring Costs		$22,480
Annual Site Monitoring (4 Quarters)		$19,680
Annual Site Maintenance		$5,000
Subtotal:		$112,139
Contingency	25%	$28,035
Subtotal Annual OM&M Costs:		**$140,173**

Capitalized Costs:

Long Term Operation Period, n (years)	40 years
Average Net Interest Rate, i	5%
Present Worth Factor (i, n)	17.159
Annual OM&M Costs:	$140,173
Present Worth Long Term OM&M Costs	$2,405,245
Initial Capital Costs:	$25,059,988
Capitalized Total Costs:	**$27,465,234**

Annualized Costs:

Long Term Operation Period, n (years)	40 years
Average Interest Rate, i	5%
Amortization Factor (i, n)	0.058
Initial Capital Costs:	$25,059,988
Amortized Capital Costs:	$1,460,450
Annual OM&M Costs:	$140,173
Annualized Total Costs:	**$1,600,623**

	quantity	unit	unit cost	subtotal
Upgradient Cutoff Trench, Pumping, &10 gpm Treatment System			**$**	**$**
Impermeable Liner, 15 ft deep, 1100 lf	16500	sf	40	$660,000
Trench Excavation, 10 ft deep	1100	lf	50	$55,000
Contaminated Soil Disposal	5500	tons	50	$275,000
Trench Filter Fabric	5000	sf	2	$10,000
Gravel Backfill	5500	tons	10	$55,000
Collection Pipe, 4" HDPE perforated	1100	lf	2	$2,200
Collection Sump	1	ls	2000	$2,000
Sump Pump, 10 gpm	1	ls	3000	$3,000
Sump Level Controls	1	ls	2000	$2,000
Electrical Conduit	1400	lf	5	$7,000
Conveyance Piping	700	lf	2	$1,400
Trenching, Backfill, & Compaction, 5 ft deep	700	lf	20	$14,000
Treatment System Building	1	ls	30000	$30,000
Settling Tank	1	ea	3000	$3,000
NAPL separator & storage tank	1	ea	3000	$3,000
Oleophilic Filter	1	ea	1000	$1,000
VOC and SVOC removal system	1	ls	40000	$40,000
Liquid Phase GAC Polishing System	1	ea	8000	$8,000
Transfer Pumps	4	ea	1000	$4,000
Flowmeters	4	ea	500	$2,000
Misc Piping, Valves, and Fittings	1	ls	5000	$5,000
Cleaning System	1	ls	5000	$5,000
Instrumentation and Control System	1	ls	7000	$7,000
Misc Electrical	1	ls	5000	$5,000
Discharge Piping, 4" PVC	500	lf	5	$2,500
Trenching, Backfill, & Compaction, 4 ft deep	500	lf	16	$8,000
Surface Restoration	1	ls	5000	$5,000
Connection to Sanitary Pump Station	1	ls	2000	$2,000
Startup Samples	100	ea	200	$20,000
Subtotal:				**$1,237,100**

	quantity	unit	unit cost	subtotal
Side& Shoreline Cutoff Walls			**$**	**$**
West Sheetpiling, 15 feet deep, 1200 lf	18000	sf	40	$720,000
East Sheetpiling, 15 feet deep, 1000 lf	15000	sf	40	$600,000
North Sheetpiling, 20 feet deep, 1500 lf	30000	sf	40	$1,200,000
Subtotal:				**$2,520,000**

	quantity	unit	unit cost	subtotal
Breakwaters			**$**	**$**
Rubble mound Breakwater, 15' deep @2900N	1500	lf	1500	$2,250,000
Subtotal:				**$2,250,000**

	quantity	unit	unit cost	subtotal
Utility Rerouting			**$**	**$**
2nd St Storm Sewer	500	lf	80	$40,000
3d St Storm sewer	500	lf	80	$40,000
Phone	1	ls	5000	$5,000
Power	1	ls	5000	$5,000
Water Piping	1	ls	1500	$1,500
Gas	1	ls	1500	$1,500
Subtotal:				**$93,000**

	quantity	unit	unit cost	subtotal
Fill Lake Area			**$**	**$**
Cutoff and Remove Old Pilings	40	ea	1000	$40,000
Remove existing shoreline riprap	7500	tons	20	$150,000
Geomembrane cover	435600	sf	4	$1,742,400
Clean FIll Cover (avg - 11' thick)	359370	tons	15	$5,390,550
Subtotal:				**$7,322,950**

	quantity	unit	unit cost	subtotal
Cover park			**$**	**$**
Clear & Grub	10	ac	1000	$10,000
1' cover	21780	tons	7	$152,460
geomembrane	435600	sf	1	$435,600
3' cover	65340	tons	7	$457,380
Geomembrane	871200	sf	1	$871,200
Clean Fill, placed & compacted	43560	tons	15	$653,400
Topsoil, placed and graded	21780	tons	10	$217,800
Seeding	20	ac	100	$2,000
New Trees	200	ea	200	$40,000
Pedestrian Walkway	1500	lf	25	$37,500
Road	45000	sf	5	$225,000
Shoreline	1500	tons	200	$300,000
Subtotal:				**$3,402,340**

	quantity	unit	unit cost	subtotal
Monitoring System			**$**	**$**
Monitoring Wells	10	ea	1000	$10,000
Oleophilic Sumps	2	ea	3000	$6,000
Subtotal:				**$16,000**

	quantity	unit	unit cost	subtotal
Annual GW Cutoff System O&M Costs			**$**	**$**
O&M Labor	144	hrs	50	$7,200
Power (75 hp * 365 days)	490779	kwhrs	0.06	$29,447
Parts Replacement	1	ls	10000	$10,000
Sanitary Disposal Fees	5256	1000 GAL	1	$5,256
NAPL Disposal Offsite	1000	gal	2	$2,000
Sludge Disposal Offsite	22	tons	50	$1,096
Carbon Replacement & Disposal	1000	lbs	5	$5,000
Bag Filter Disposal	1	ls	500	$500
O&M Status Reports	64	hrs	70	$4,480
Subtotal:				**$64,979**

	quantity	unit	unit cost	subtotal
Annual Remediation System Performance Monitoring Costs			**$**	**$**
Sampling Labor	48	hrs	50	$2,400
Equipment	12	days	500	$6,000
Lab Analyses	48	sample	200	$9,600
Status Reports	64	hrs	70	$4,480
Subtotal:				**$22,480**

	quantity	unit	unit cost	subtotal
Annual Site Monitoring (4 Quarters)			**$**	**$**
Well development labor	96	hrs	50	$4,800
Analyses -6 monitoring points	24	samples	250	$6,000
Sampling Labor (GW samples)	48	hrs	50	$2,400
Equipment	4	days	500	$2,000
Reporting	64	hrs	70	$4,480
Subtotal:				**$19,680**

	quantity	unit	unit cost	subtotal
Annual Site Maintenance			**$**	**$**
Shoreline Erosion Control	1	ls	5000	$5,000
Subtotal:				**$5,000**

Feasibility Study Cost Projections
Remedial Action Option #C2: Confine and Armorstone Contaminated Sediment Area

Project: Ashland Lakefront - Comprehensive FS
SEH# WIDNR9401

CALC'D 'BY: MJB 18 November 1998
CHECKED BY: GPW 9 Dec 98

PRELIMINARY COST PROJECTION SUMMARY - RAO#C-2

Remedial Action Initial Capital Costs:

Upgradient Cutoff Trench, Pumping, &10 gpm Treatment System		$1,237,100	
Side& Shoreline Cutoff Walls		$2,220,000	
Breakwaters		$1,200,000	
Utility Rerouting		$93,000	
Armorstone Lake Area		$5,308,300	
Cover park		$3,402,340	
Monitoring System		$16,000	
Subtotal:		$13,476,740	
Contingency	20%	$2,695,348	
Subtotal:		$16,172,088	
Planning and Permitting:	7%	$1,132,046	
Pilot Tests	3%	$485,163	
Engineering	10%	$1,617,209	
Construction Oversight	10%	$1,617,209	
Subtotal, Remedial Action Initial Capital Costs:			$21,023,714
Subtotal,Initial Capital Costs:			**$21,023,714**

Long Term Operations, Maintenance, and Monitoring Costs:

Annual GW Cutoff System O&M Costs		$64,979
Annual Remediation System Performance Monitoring Costs		$22,480
Annual Site Monitoring (4 Quarters)		$19,680
Annual Site Maintenance		$5,000
Subtotal:		$112,139
Contingency	25%	$28,035
Subtotal Annual OM&M Costs:		**$140,173**

Capitalized Costs:

Long Term Operation Period, n (years)	40 years
Average Net Interest Rate, i	5%
Present Worth Factor (i, n)	17.159
Annual OM&M Costs:	$140,173
Present Worth Long Term OM&M Costs	$2,405,245
Initial Capital Costs:	$21,023,714
Capitalized Total Costs:	**$23,428,960**

Annualized Costs:

Long Term Operation Period, n (years)	40 years
Average Interest Rate, i	5%
Amortization Factor (i, n)	0.058
Initial Capital Costs:	$21,023,714
Amortized Capital Costs:	$1,225,223
Annual OM&M Costs:	$140,173
Annualized Total Costs:	**$1,365,397**

	quantity	unit	unit cost	subtotal
Upgradient Cutoff Trench, Pumping, &10 gpm Treatment System			**$**	**$**
Impermeable Liner, 15 ft deep, 1100 lf	16500	sf	40	$660,000
Trench Excavation, 10 ft deep	1100	lf	50	$55,000
Contaminated Soil Disposal	5500	tons	50	$275,000
Trench Filter Fabric	5000	sf	2	$10,000
Gravel Backfill	5500	tons	10	$55,000
Collection Pipe, 4" HDPE perforated	1100	lf	2	$2,200
Collection Sump	1	ls	3000	$3,000
Sump Pump, 10 gpm	1	ls	2000	$2,000
Sump Level Controls	1	ls	2000	$2,000
Electrical Conduit	1400	lf	5	$7,000
Conveyance Piping	700	lf	2	$1,400
Trenching, Backfill, & Compaction, 5 ft deep	700	lf	20	$14,000
Treatment System Building	1	ls	30000	$30,000
Settling Tank	1	ea	3000	$3,000
NAPL separator & storage tank	1	ea	3000	$3,000
Oleophilic Filter	1	ea	1000	$1,000
VOC and SVOC removal system	1	ls	40000	$40,000
Liquid Phase GAC Polishing System	1	ea	8000	$8,000
Transfer Pumps	4	ea	1000	$4,000
Flowmeters	4	ea	500	$2,000
Misc Piping, Valves, and Fittings	1	ls	5000	$5,000
Cleaning System	1	ls	5000	$5,000
Instrumentation and Control System	1	ls	7000	$7,000
Misc Electrical	1	ls	5000	$5,000
Discharge Piping, 4" PVC	500	lf	5	$2,500
Trenching, Backfill, & Compaction, 4 ft deep	500	lf	16	$8,000
Surface Restoration	1	ls	5000	$5,000
Connection to Sanitary Pump Station	1	ls	2000	$2,000
Startup Samples	100	ea	200	$20,000
Subtotal:				**$1,237,100**

	quantity	unit	unit cost	subtotal
Side& Shoreline Cutoff Walls			**$**	**$**
West Sheetpiling, 15 feet deep, 1200 lf	18000	sf	40	$720,000
East Sheetpiling, 15 feet deep, 1000 lf	15000	sf	40	$600,000
North Sheetpiling, 15 feet deep, 1500 lf	22500	sf	40	$900,000
Subtotal:				**$2,220,000**

	quantity	unit	unit cost	subtotal
Breakwaters			**$**	**$**
Subsurface bump, 12' deep @2900N	1500	lf	800	$1,200,000
Subtotal:				**$1,200,000**

	quantity	unit	unit cost	subtotal
Utility Rerouting			**$**	**$**
2nd St Storm Sewer	500	lf	80	$40,000
3d St Storm sewer	500	lf	80	$40,000
Phone	1	ls	5000	$5,000
Power	1	ls	5000	$5,000
Water Piping	1	ls	1500	$1,500
Gas	1	ls	1500	$1,500
Subtotal:				**$93,000**

	quantity	unit	unit cost	subtotal
Armorstone Lake Area			**$**	**$**
Cutoff and Remove Old Pilings	40	ea	1000	$40,000
Remove existing shoreline riprap	7500	tons	20	$150,000
1' bedding layer, placed	21780	tons	25	$544,500
Geomembrane cover	435600	sf	4	$1,742,400
1' sand cover	21780	tons	25	$544,500
1' gravel cover	21780	tons	25	$544,500
18" armorstone	43560	tons	40	$1,742,400
Subtotal:				**$5,308,300**

	quantity	unit	unit cost	subtotal
Cover park			**$**	**$**
Clear & Grub	10	ac	1000	$10,000
1' cover	21780	tons	7	$152,460
geomembrane	435600	sf	1	$435,600
3' cover	65340	tons	7	$457,380
Geomembrane	871200	sf	1	$871,200
Clean Fill, placed & compacted	43560	tons	15	$653,400
Topsoil, placed and graded	21780	tons	10	$217,800
Seeding	20	ac	100	$2,000
New Trees	200	ea	200	$40,000
Pedestrian Walkway	1500	lf	25	$37,500
Road	45000	sf	5	$225,000
Shoreline	1500	tons	200	$300,000
Subtotal:				**$3,402,340**

	quantity	unit	unit cost	subtotal
Monitoring System			**$**	**$**
Monitoring Wells	10	ea	1000	$10,000
Oleophilic Sumps	2	ea	3000	$6,000
Subtotal:				**$16,000**

	quantity	unit	unit cost	subtotal
Annual GW Cutoff System O&M Costs			**$**	**$**
O&M Labor	144	hrs	50	$7,200
Power (75 hp * 365 days)	490779	kwhrs	0.06	$29,447
Parts Replacement	1	ls	10000	$10,000
Sanitary Disposal Fees	5256	1000 GAL	1	$5,256
NAPL Disposal Offsite	1000	gal	2	$2,000
Sludge Disposal Offsite	22	tons	50	$1,096
Carbon Replacement & Disposal	1000	lbs	5	$5,000
Bag Filter Disposal	1	ls	500	$500
O&M Status Reports	64	hrs	70	$4,480
Subtotal:				**$64,979**

	quantity	unit	unit cost	subtotal
Annual Remediation System Performance Monitoring Costs			**$**	**$**
Sampling Labor	48	hrs	50	$2,400
Equipment	12	days	500	$6,000
Lab Analyses	48	sample	200	$9,600
Status Reports	64	hrs	70	$4,480
Subtotal:				**$22,480**

	quantity	unit	unit cost	subtotal
Annual Site Monitoring (4 Quarters)			**$**	**$**
Well development labor	96	hrs	50	$4,800
Analyses -6 monitoring points	24	samples	250	$6,000
Sampling Labor (GW samples)	48	hrs	50	$2,400
Equipment	4	days	500	$2,000
Reporting	64	hrs	70	$4,480
Subtotal:				**$19,680**

	quantity	unit	unit cost	subtotal
Annual Site Maintenance			**$**	**$**
General	1	ls	5000	$5,000
Subtotal:				**$5,000**

Feasibility Study Cost Projections
Remedial Action Option #D1: Fill in Contaminated Sediment Area, In-situ Treatment

Project: Ashland Lakefront - Comprehensive FS
SEH# WIDNR9401

CALC'D 'BY: MJB 18 Nov 1998
CHECKED BY: GPW 9 Dec 98

PRELIMINARY COST PROJECTION SUMMARY - RAO#D-1

Remedial Action Initial Capital Costs:

Upgradient Cutoff Trench, Pumping, &10 gpm Treatment System		$1,237,100	
Side& Shoreline Cutoff Walls		$2,520,000	
Breakwaters		$2,250,000	
Utility Rerouting		$93,000	
Fill Lake Area		$5,580,550	
Aggressive In-situ Remediation		$6,350,000	
Secondary In situ Remediation		$2,634,000	
Sitework 100 GPM Liquid Collection/Treatment System		$2,055,530	
Site Restoration		$2,346,900	
Monitoring System		$16,000	
Subtotal:		$25,083,080	
Contingency	20%	$5,016,616	
Subtotal:		$30,099,696	
Planning and Permitting:	5%	$1,504,985	
Pilot Tests	5%	$1,504,985	
Engineering	7%	$2,106,979	
Construction Oversight	7%	$2,106,979	
Subtotal, Remedial Action Initial Capital Costs:			$37,323,623
Subtotal,Initial Capital Costs:			**$37,323,623**

Long Term Operations, Maintenance, and Monitoring Costs:

Annual GW Cutoff System O&M Costs		$64,979
Annual Remediation System Performance Monitoring Costs		$22,480
Annual Site Monitoring (4 Quarters)		$19,680
Annual Site Maintenance		$5,000
Subtotal:		$112,139
Contingency	25%	$28,035
Subtotal Annual OM&M Costs:		**$140,173**

Capitalized Costs:

Long Term Operation Period, n (years)	40	years
Average Net Interest Rate, i	5%	
Present Worth Factor (i, n)	17.159	
Annual OM&M Costs:	$140,173	
Present Worth Long Term OM&M Costs	$2,405,245	
Initial Capital Costs:	$37,323,623	
Capitalized Total Costs:	**$39,728,868**	

Annualized Costs:

Long Term Operation Period, n (years)	40	years
Average Interest Rate, i	5%	
Amortization Factor (i, n)	0.058	
Initial Capital Costs:	$37,323,623	
Amortized Capital Costs:	$2,175,152	
Annual OM&M Costs:	$140,173	
Annualized Total Costs:	**$2,315,325**	

	quantity	unit	unit cost	subtotal
Upgradient Cutoff Trench, Pumping, &10 gpm Treatment System			**$**	**$**
Impermeable Liner, 15 ft deep, 1100 lf	16500	sf	40	$660,000
Trench Excavation, 10 ft deep	1100	lf	50	$55,000
Contaminated Soil Disposal	5500	tons	50	$275,000
Trench Filter Fabric	5000	sf	2	$10,000
Gravel Backfill	5500	tons	10	$55,000
Collection Pipe, 4" HDPE perforated	1100	lf	2	$2,200
Collection Sump	1	ls	2000	$2,000
Sump Pump, 10 gpm	1	ls	3000	$3,000
Sump Level Controls	1	ls	2000	$2,000
Electrical Conduit	1400	lf	5	$7,000
Conveyance Piping	700	lf	2	$1,400
Trenching, Backfill, & Compaction, 5 ft deep	700	lf	20	$14,000
Treatment System Building	1	ls	30000	$30,000
Settling Tank	1	ea	3000	$3,000
NAPL separator & storage tank	1	ea	3000	$3,000
Oleophilic Filter	1	ea	1000	$1,000
VOC and SVOC removal system	1	ls	40000	$40,000
Liquid Phase GAC Polishing System	1	ea	8000	$8,000
Transfer Pumps	4	ea	1000	$4,000
Flowmeters	4	ea	500	$2,000
Misc Piping, Valves, and Fittings	1	ls	5000	$5,000
Cleaning System	1	ls	5000	$5,000
Instrumentation and Control System	1	ls	7000	$7,000
Misc Electrical	1	ls	5000	$5,000
Discharge Piping, 4" PVC	500	lf	5	$2,500
Trenching, Backfill, & Compaction, 4 ft deep	500	lf	16	$8,000
Surface Restoration	1	ls	5000	$5,000
Connection to Sanitary Pump Station	1	ls	2000	$2,000
Startup Samples	100	ea	200	$20,000
Subtotal:				**$1,237,100**

	quantity	unit	unit cost	subtotal
Side& Shoreline Cutoff Walls			**$**	**$**
West Sheetpiling, 15 feet deep, 1200 lf	18000	sf	40	$720,000
East Sheetpiling, 15 feet deep, 1000 lf	15000	sf	40	$600,000
North Sheetpiling, 20 feet deep, 1500 lf	30000	sf	40	$1,200,000
Subtotal:				**$2,520,000**

	quantity	unit	unit cost	subtotal
Breakwaters			**$**	**$**
Rubble mound Breakwater, 15' deep @2900N	1500	lf	1500	$2,250,000
Subtotal:				**$2,250,000**

	quantity	unit	unit cost	subtotal
Utility Rerouting			**$**	**$**
2nd St Storm Sewer	500	lf	80	$40,000
3d St Storm sewer	500	lf	80	$40,000
Phone	1	ls	5000	$5,000
Power	1	ls	5000	$5,000
Water Piping	1	ls	1500	$1,500
Gas	1	ls	1500	$1,500
Subtotal:				**$93,000**

	quantity	unit	unit cost	subtotal
Fill Lake Area			**$**	**$**
Cutoff and Remove Old Pilings	40	ea	1000	$40,000
Remove existing shoreline riprap	7500	tons	20	$150,000
Cover (avg - 11' thick)	359370	tons	15	$5,390,550
Subtotal:				**$5,580,550**

	quantity	unit	unit cost	subtotal
Aggressive In-situ Remediation			**$**	**$**
Vertical wells	1000	ea	100	$100,000
Piping	1	ls	100000	$100,000
Power supply	1	ls	50000	$50,000
Steam stripping Implementation	2	yr	3000000	$6,000,000
DNAPL disposal	100000	gal	1	$100,000
Subtotal:				**$6,350,000**

	quantity	unit	unit cost	subtotal
Secondary In situ Remediation			**$**	**$**
Reagent/Surfactant Injection	200000	gal	5	$1,000,000
Injection System	1	ls	250000	$250,000
Piping	15000	lf	15	$225,000
Discharge Pumps	2	ea	2000	$4,000
Discharge Piping	500	lf	10	$5,000
Controls and Electrical	1	ls	50000	$50,000
Air collection and Treatment system	1	ls	100000	$100,000
OM&M Costs (power, carbon, monitoring, labor)	10	yr	100000	$1,000,000
Subtotal:				**$2,634,000**

Sitework 100 GPM Liquid Collection/Treatment System	quantity	unit	unit cost $	subtotal $
Treatment Building Renovation	1	ls	100000	$100,000
Settling Tank	1	ea	9000	$9,000
NAPL separator & storage tank	1	ea	12000	$12,000
Oleophilic Filter	1	ea	5000	$5,000
VOC and SVOC removal system	1	ls	80000	$80,000
DAF System	1	ls	250000	$250,000
Suspended Solids Filter	1	ea	15000	$15,000
Liquid Phase GAC Polishing System	1	ea	15000	$15,000
Transfer Pumps, 100 gpm	4	ea	1500	$6,000
Flowmeters	4	ea	1000	$4,000
Misc Piping, Valves, and Fittings	1	ls	20000	$20,000
Cleaning System	1	ls	20000	$20,000
Instrumentation and Control System	1	ls	20000	$20,000
Misc Electrical	1	ls	20000	$20,000
Discharge Piping, 4" PVC	50	lf	5	$250
Trenching, Backfill, & Compaction, 4 ft deep	50	lf	16	$800
Connection to Sanitary Lift Station	1	ls	2000	$2,000
OM&M Costs (power, carbon, monitoring, labor)	12	yr	100000	$1,200,000
Sanitary Discharge Fee	138,240	x1000 gal	2	$276,480
Subtotal:				**$2,055,530**

Site Restoration	quantity	unit	unit cost $	subtotal $
Geomembrane	871200	sf	1	$871,200
Clean Fill, placed & compacted	43560	tons	15	$653,400
Topsoil, placed and graded	21780	tons	10	$217,800
Seeding	20	ac	100	$2,000
New Trees	200	ea	200	$40,000
Pedestrian Walkway	1500	lf	25	$37,500
Road	45000	sf	5	$225,000
Shoreline	1500	tons	200	$300,000
Subtotal:				**$2,346,900**

Monitoring System	quantity	unit	unit cost $	subtotal $
Monitoring Wells	10	ea	1000	$10,000
Oleophilic Sumps	2	ea	3000	$6,000
Subtotal:				**$16,000**

	quantity	unit	unit cost	subtotal
Annual GW Cutoff System O&M Costs			**$**	**$**
O&M Labor	144	hrs	50	$7,200
Power (75 hp * 365 days)	490779	kwhrs	0.06	$29,447
Parts Replacement	1	ls	10000	$10,000
Sanitary Disposal Fees	5256	1000 GAL	1	$5,256
NAPL Disposal Offsite	1000	gal	2	$2,000
Sludge Disposal Offsite	22	tons	50	$1,096
Carbon Replacement & Disposal	1000	lbs	5	$5,000
Bag Filter Disposal	1	ls	500	$500
O&M Status Reports	64	hrs	70	$4,480
Subtotal:				**$64,979**

	quantity	unit	unit cost	subtotal
Annual Remediation System Performance Monitoring Costs			**$**	**$**
Sampling Labor	48	hrs	50	$2,400
Equipment	12	days	500	$6,000
Lab Analyses	48	sample	200	$9,600
Status Reports	64	hrs	70	$4,480
Subtotal:				**$22,480**

	quantity	unit	unit cost	subtotal
Annual Site Monitoring (4 Quarters)			**$**	**$**
Well development labor	96	hrs	50	$4,800
Analyses -6 monitoring points	24	samples	250	$6,000
Sampling Labor (GW samples)	48	hrs	50	$2,400
Equipment	4	days	500	$2,000
Reporting	64	hrs	70	$4,480
Subtotal:				**$19,680**

	quantity	unit	unit cost	subtotal
Annual Site Maintenance			**$**	**$**
General	1	ls	5000	$5,000
Subtotal:				**$5,000**

Feasibility Study Cost Projections
Remedial Action Option #D2: Dredge to Confined Treatment Facility, In-situ Treatment

Project: Ashland Lakefront - Comprehensive FS
SEH# WIDNR9401

CALC'D 'BY: MJB 18 Nov 1998
CHECKED BY: GPW 9 Dec 98

PRELIMINARY COST PROJECTION SUMMARY - RAO#D-2

Remedial Action Initial Capital Costs:

Upgradient Cutoff Trench, Pumping, &10 gpm Treatment System		$1,237,100	
Side& Shoreline Cutoff Walls		$2,520,000	
Breakwaters		$2,950,000	
Utility Rerouting		$93,000	
Sediment Dredging		$5,341,500	
Sediment Processing		$9,354,920	
Aggressive In-situ Remediation		$4,772,720	
Secondary In situ Remediation		$2,482,000	
Sitework 100 GPM Water Collection/Treatment System		$2,055,530	
Site Restoration		$1,649,140	
Monitoring System		$16,000	
Subtotal:		$32,471,910	
Contingency	20%	$6,494,382	
Subtotal:		$38,966,292	
Planning and Permitting:	5%	$1,948,315	
Pilot Tests	5%	$1,948,315	
Engineering	7%	$2,727,640	
Construction Oversight	7%	$2,727,640	
Subtotal, Remedial Action Initial Capital Costs:			$48,318,202
Subtotal,Initial Capital Costs:			**$48,318,202**

Long Term Operations, Maintenance, and Monitoring Costs:

Annual GW Cutoff System O&M Costs		$64,979
Annual Remediation System Performance Monitoring Costs		$22,480
Annual Site Monitoring (4 Quarters)		$19,680
Annual Site Maintenance		$5,000
Subtotal:		$112,139
Contingency	25%	$28,035
Subtotal Annual OM&M Costs:		**$140,173**

Capitalized Costs:

Long Term Operation Period, n (years)	40 years
Average Net Interest Rate, i	5%
Present Worth Factor (i, n)	17.159
Annual OM&M Costs:	$140,173
Present Worth Long Term OM&M Costs	$2,405,245
Initial Capital Costs:	$48,318,202
Capitalized Total Costs:	**$50,723,447**

Annualized Costs:

Long Term Operation Period, n (years)	40 years
Average Interest Rate, i	5%
Amortization Factor (i, n)	0.058
Initial Capital Costs:	$48,318,202
Amortized Capital Costs:	$2,815,896
Annual OM&M Costs:	$140,173
Annualized Total Costs:	**$2,956,069**

Upgradient Cutoff Trench, Pumping, &10 gpm Treatment System	quantity	unit	unit cost $	subtotal $
Impermeable Liner, 15 ft deep	16500	lf	40	$660,000
Trench Excavation, 10 ft deep	1100	lf	50	$55,000
Contaminated Soil Disposal	5500	tons	50	$275,000
Trench Filter Fabric	5000	sf	2	$10,000
Gravel Backfill	5500	tons	10	$55,000
Collection Pipe, 4" HDPE perforated	1100	lf	2	$2,200
Collection Sump	1	ls	2000	$2,000
Sump Pump, 10 gpm	1	ls	3000	$3,000
Sump Level Controls	1	ls	2000	$2,000
Electrical Conduit	1400	lf	5	$7,000
Conveyance Piping	700	lf	2	$1,400
Trenching, Backfill, & Compaction, 5 ft deep	700	lf	20	$14,000
Treatment System Building	1	ls	30000	$30,000
Settling Tank	1	ea	3000	$3,000
NAPL separator & storage tank	1	ea	3000	$3,000
Oleophilic Filter	1	ea	1000	$1,000
VOC and SVOC removal system	1	ls	40000	$40,000
Liquid Phase GAC Polishing System	1	ea	8000	$8,000
Transfer Pumps	4	ea	1000	$4,000
Flowmeters	4	ea	500	$2,000
Misc Piping, Valves, and Fittings	1	ls	5000	$5,000
Cleaning System	1	ls	5000	$5,000
Instrumentation and Control System	1	ls	7000	$7,000
Misc Electrical	1	ls	5000	$5,000
Discharge Piping, 4" PVC	500	lf	5	$2,500
Trenching, Backfill, & Compaction, 4 ft deep	500	lf	16	$8,000
Surface Restoration	1	ls	5000	$5,000
Connection to Sanitary Pump Station	1	ls	2000	$2,000
Startup Samples	100	ea	200	$20,000
Subtotal:				**$1,237,100**

Side& Shoreline Cutoff Walls	quantity	unit	unit cost $	subtotal $
West Sheetpiling, 15 feet deep, 1200 lf	18000	sf	40	$720,000
East Sheetpiling, 15 feet deep, 1000 lf	15000	sf	40	$600,000
North Sheetpiling, 20 feet deep, 1500 lf	30000	sf	40	$1,200,000
Subtotal:				**$2,520,000**

Breakwaters	quantity	unit	unit cost $	subtotal $
Rubble mound Breakwater, 15' deep @2900N	1500	lf	1500	$2,250,000
Parallel Sheetpile Breakwater, 15'deep @2500N	700	lf	1000	$700,000
Subtotal:				**$2,950,000**

Utility Rerouting	quantity	unit	unit cost $	subtotal $
2nd St Storm Sewer	500	lf	80	$40,000
3d St Storm sewer	500	lf	80	$40,000
Phone	1	ls	5000	$5,000
Power	1	ls	5000	$5,000
Water Piping	1	ls	1500	$1,500
Gas	1	ls	1500	$1,500
Subtotal:				**$93,000**

Sediment Dredging	quantity	unit	unit cost $	subtotal $
Cutoff and Remove Old Pilings	40	ea	1000	$40,000
Remove existing shoreline riprap	7500	tons	20	$150,000
Hydraulic Dredging	152460	tons	25	$3,811,500
Mechanical Dredging, Standby	540	days	1000	$540,000
Temporary barriers	80000	sf	10	$800,000
Subtotal:				**$5,341,500**

Sediment Processing	quantity	unit	unit cost $	subtotal $
Renovate WWTP building	1	ls	200000	$200,000
Pumps & Piping	1	ls	100000	$100,000
Controls	1	ls	20000	$20,000
Power Hookup	1	ls	10000	$10,000
Coarse sand dewatering basin	1	ls	40000	$40,000
Flocculent tank & mixer	1	ls	60000	$60,000
Filter Press	1	ls	200000	$200,000
Air Treatment Equipment	1	ls	200000	$200,000
Processing	720	days	1000	$720,000
Sediment Slurry Processing	150,000,000	gallons	0.05	$7,500,000
Transport solids to confined treatment facility	152460	tons	2	$304,920
Subtotal:				**$9,354,920**

Aggressive In-situ Remediation	quantity	unit	unit cost $	subtotal $
Vertical wells	5227.2	ac	100	$522,720
Piping	1	ls	100000	$100,000
Power supply	1	ls	50000	$50,000
Steam stripping system & power use	2	yr	2000000	$4,000,000
DNAPL disposal	100000	gal	1	$100,000
Subtotal:				**$4,772,720**

Secondary In situ Remediation	quantity	unit	unit cost $	subtotal $
Reagent/Surfactant Injection	200000	gal	5	$1,000,000
Injection System	1	ls	250000	$250,000
Piping	5000	lf	15	$75,000
Discharge Pump	2	ea	1000	$2,000
Discharge Piping	500	lf	10	$5,000
Controls and Electrical	1	ls	50000	$50,000
Air collection and Treatment system	1	ls	100000	$100,000
OM&M Costs (power, carbon, monitoring, labor)	10	yr	100000	$1,000,000
Subtotal:				**$2,482,000**

Sitework 100 GPM Water Collection/Treatment System	quantity	unit	unit cost $	subtotal $
Treatment Building Renovations	1	ls	100000	$100,000
Settling Tank	1	ea	9000	$9,000
NAPL separator & storage tank	1	ea	12000	$12,000
Oleophilic Filter	1	ea	5000	$5,000
DAF System	1	ls	250000	$250,000
VOC and SVOC removal system	1	ls	80000	$80,000
Suspended Solids Filter	1	ea	15000	$15,000
Liquid Phase GAC Polishing System	1	ea	15000	$15,000
Transfer Pumps, 100 gpm	4	ea	1500	$6,000
Flowmeters	4	ea	1000	$4,000
Misc Piping, Valves, and Fittings	1	ls	20000	$20,000
Cleaning System	1	ls	20000	$20,000
Instrumentation and Control System	1	ls	20000	$20,000
Misc Electrical	1	ls	20000	$20,000
Discharge Piping, 4" PVC	50	lf	5	$250
Trenching, Backfill, & Compaction, 4 ft deep	50	lf	16	$800
Connection to Sanitary Lift Station	1	ls	2000	$2,000
OM&M Costs (power, carbon, monitoring, labor)	12	yr	100000	$1,200,000
Sanitary Discharge Fee	138,240	x1000 gal	2	$276,480
Subtotal:				**$2,055,530**

Site Restoration	quantity	unit	unit cost $	subtotal $
Geomembrane	522720	sf	1	$522,720
Clean Fill, placed & compacted	26136	tons	15	$392,040
Topsoil, placed and graded	13068	tons	10	$130,680
Seeding	12	ac	100	$1,200
New Trees	200	ea	200	$40,000
Pedestrian Walkway	1500	lf	25	$37,500
Road	45000	sf	5	$225,000
Shoreline	1500	tons	200	$300,000
Subtotal:				**$1,649,140**

Monitoring System	quantity	unit	unit cost $	subtotal $
Monitoring Wells	10	ea	1000	$10,000
Oleophilic Sumps	2	ea	3000	$6,000
Subtotal:				**$16,000**

	quantity	unit	unit cost	subtotal
Annual GW Cutoff System O&M Costs			**$**	**$**
O&M Labor	144	hrs	50	$7,200
Power (75 hp * 365 days)	490779	kwhrs	0.06	$29,447
Parts Replacement	1	ls	10000	$10,000
Sanitary Disposal Fees	5256	1000 GAL	1	$5,256
NAPL Disposal Offsite	1000	gal	2	$2,000
Sludge Disposal Offsite	22	tons	50	$1,096
Carbon Replacement & Disposal	1000	lbs	5	$5,000
Bag Filter Disposal	1	ls	500	$500
O&M Status Reports	64	hrs	70	$4,480
Subtotal:				**$64,979**

	quantity	unit	unit cost	subtotal
Annual Remediation System Performance Monitoring Costs			**$**	**$**
Sampling Labor	48	hrs	50	$2,400
Equipment	12	days	500	$6,000
Lab Analyses	48	sample	200	$9,600
Status Reports	64	hrs	70	$4,480
Subtotal:				**$22,480**

	quantity	unit	unit cost	subtotal
Annual Site Monitoring (4 Quarters)			**$**	**$**
Well development labor	96	hrs	50	$4,800
Analyses -6 monitoring points	24	samples	250	$6,000
Sampling Labor (GW samples)	48	hrs	50	$2,400
Equipment	4	days	500	$2,000
Reporting	64	hrs	70	$4,480
Subtotal:				**$19,680**

	quantity	unit	unit cost	subtotal
Annual Site Maintenance			**$**	**$**
General	1	ls	5000	$5,000
Subtotal:				**$5,000**

Feasibility Study Cost Projections
Remedial Action Option #E1: Phased Dredging/Excavation and Separation
with Off-site Co-burning of Wood at Power Plant and On-site Thermal Treatment of Soils
Project: Ashland Lakefront - Comprehensive FS
SEH# WIDNR9401

CALC'D 'BY: MJB 18 Nov 98
CHECKED BY: GPW 9 Dec 98

PRELIMINARY COST PROJECTION SUMMARY - RAO#E1

Remedial Action Initial Capital Costs:

Upgradient Cutoff Trench, Pumping, &10 gpm Treatment System		$1,237,100	
Side& Shoreline Cutoff Walls		$2,520,000	
Breakwater 2900N & Cutoff wall		$2,250,000	
Utility Rerouting		$93,000	
Sediment Dredging		$7,255,000	
Sediment Treatment		$23,476,000	
Landside pretreatment		$1,500,000	
Excavation, Transportation, and Treatment/Disposal		$16,326,240	
Excavated Solids Dewatering & Separation System		$2,476,000	
Sitework 100 GPM Water Collection/Treatment System		$1,175,530	
WWTP Cell Treatment System		$200,000	
Site Restoration		$1,039,100	
Monitoring System		$16,000	
Subtotal:		$59,563,970	
Contingency	20%	$11,912,794	
Subtotal:		$71,476,764	
Planning and Permitting:	5%	$3,573,838	
Pilot Tests	5%	$3,573,838	
Engineering	7%	$5,003,373	
Construction Oversight	7%	$5,003,373	
Subtotal, Remedial Action Initial Capital Costs:			$88,631,187
Subtotal,Initial Capital Costs:			**$88,631,187**

Long Term Operations, Maintenance, and Monitoring Costs:

Annual GW Cutoff System O&M Costs		$64,983
Annual WWTP Cell System O&M Costs		$62,033
Annual Remediation System Performance Monitoring Costs		$44,960
Annual Site Monitoring (4 Quarters)		$28,480
Annual Site Maintenance		$5,000
Subtotal:		$205,455
Contingency	25%	$51,364
Subtotal Annual OM&M Costs:		**$256,819**

Capitalized Costs:

Long Term Operation Period, n (years)	40	years
Average Net Interest Rate, i	5%	
Present Worth Factor (i, n)	17.159	
Annual OM&M Costs:	$256,819	
Present Worth Long Term OM&M Costs	$4,406,785	
Initial Capital Costs:	$88,631,187	
Capitalized Total Costs:	**$93,037,973**	

Annualized Costs:

Long Term Operation Period, n (years)	40	years
Average Interest Rate, i	5%	
Amortization Factor (i, n)	0.058	
Initial Capital Costs:	$88,631,187	
Amortized Capital Costs:	$5,165,263	
Annual OM&M Costs:	$256,819	
Annualized Total Costs:	**$5,422,082**	

Upgradient Cutoff Trench, Pumping, &10 gpm Treatment System	quantity	unit	unit cost $	subtotal $
Impermeable Liner, 15 ft deep, 1100 lf	16500	sf	40	$660,000
Trench Excavation, 10 ft deep	1100	lf	50	$55,000
Contaminated Soil Disposal	5500	tons	50	$275,000
Trench Filter Fabric	5000	sf	2	$10,000
Gravel Backfill	5500	tons	10	$55,000
Collection Pipe, 4" HDPE perforated	1100	lf	2	$2,200
Collection Sump	1	ls	2000	$2,000
Sump Pump, 10 gpm	1	ls	3000	$3,000
Sump Level Controls	1	ls	2000	$2,000
Electrical Conduit	1400	lf	5	$7,000
Conveyance Piping	700	lf	2	$1,400
Trenching, Backfill, & Compaction, 5 ft deep	700	lf	20	$14,000
Treatment System Building	1	ls	30000	$30,000
Settling Tank	1	ea	3000	$3,000
NAPL separator & storage tank	1	ea	3000	$3,000
Oleophilic Filter	1	ea	1000	$1,000
VOC and SVOC removal system	1	ls	40000	$40,000
Liquid Phase GAC Polishing System	1	ea	8000	$8,000
Transfer Pumps	4	ea	1000	$4,000
Flowmeters	4	ea	500	$2,000
Misc Piping, Valves, and Fittings	1	ls	5000	$5,000
Cleaning System	1	ls	5000	$5,000
Instrumentation and Control System	1	ls	7000	$7,000
Misc Electrical	1	ls	5000	$5,000
Discharge Piping, 4" PVC	500	lf	5	$2,500
Trenching, Backfill, & Compaction, 4 ft deep	500	lf	16	$8,000
Surface Restoration	1	ls	5000	$5,000
Connection to Sanitary Pump Station	1	ls	2000	$2,000
Startup Samples	100	ea	200	$20,000
Subtotal:				**$1,237,100**

Side& Shoreline Cutoff Walls	quantity	unit	unit cost $	subtotal $
West Sheetpiling, 15 feet deep, 1200 lf	18000	sf	40	$720,000
East Sheetpiling, 15 feet deep, 1000 lf	15000	sf	40	$600,000
North Sheetpiling, 20 feet deep, 1500 lf	30000	sf	40	$1,200,000
Subtotal:				**$2,520,000**

Breakwater 2900N & Cutoff wall	quantity	unit	unit cost $	subtotal $
Rubble mound Breakwater, 15' deep	1500	lf	1500	$2,250,000
Subtotal:				**$2,250,000**

Utility Rerouting	quantity	unit	unit cost $	subtotal $
2nd St Storm Sewer	500	lf	80	$40,000
3d St Storm sewer	500	lf	80	$40,000
Phone	1	ls	5000	$5,000
Power	1	ls	5000	$5,000
Water Piping	1	ls	1500	$1,500
Gas	1	ls	1500	$1,500
Subtotal:				**$93,000**

Sediment Dredging	quantity	unit	unit cost $	subtotal $
Cutoff and Remove Old Pilings	40	ea	1000	$40,000
Remove existing shoreline riprap	7500	tons	20	$150,000
Hydraulic Dredging	217800	tons	25	$5,445,000
Mechanical Dredging, Standby	720	days	1000	$720,000
Confirmation Samples	1000	ea	100	$100,000
Temporary barriers	80000	sf	10	$800,000
Subtotal:				**$7,255,000**

Sediment Treatment	quantity	unit	unit cost $	subtotal $
Renovate WWTP building	1	ls	200000	$200,000
Pumps & Piping	1	ls	100000	$100,000
Controls	1	ls	20000	$20,000
Power Hookup	1	ls	10000	$10,000
Coarse sand dewatering basin	1	ls	40000	$40,000
Flocculent tank & mixer	1	ls	60000	$60,000
Filter Press	1	ls	200000	$200,000
Air Treatment Equipment	1	ls	200000	$200,000
Processing	720	days	1000	$720,000
Sediment Slurry Processing	200,000,000	gallons	0.05	$10,000,000
Place Soils in Trucks	215800	tons	10	$2,158,000
Transport to On-site Thermal Treatment Plant	215800	tons	2	$431,600
On-site Thermal Treatment	215800	tons	45	$9,711,000
Treatment Samples	5000	ea	100	$500,000
Shred Wood Materials	2000	tons	10	$20,000
Load to Railcar	2000	tons	2	$4,000
Transport to Power Plant	2000	tons	2	$4,000
Co-burning Wood as Fuel (credit)	2000	tons	-5	($10,000)
Dispose of NAPL offsite	5000	gal	2	$10,000
Backfill and Compact Treated Soils	215800	tons	3	$647,400
Subtotal:				**$23,476,000**

Landside pretreatment	quantity	unit	unit cost $	subtotal $
Dewatering	10	ac	50000	$500,000
Air Sparging	10	ac	50000	$500,000
Soil Vapor Extraction	10	ac	50000	$500,000
Subtotal:				**$1,500,000**

Excavation, Transportation, and Treatment/Disposal	quantity	unit	unit cost $	subtotal $
Site Preparation - Clearing & Stripping	10	ac	1500	$15,000
Temporary Structure	2	ea	150000	$300,000
Air Collection and Treatment System	2	ea	50000	$100,000
OM&M Costs (power, carbon, monitoring, labor,cleaning)	3	yr	150000	$450,000
Temporary Sheetpiling, 15 ft deep, two 1100 lf walls	33000	sf	20	$660,000
Excavation	217800	tons	15	$3,267,000
Confirmatory Samples	1000	ea	100	$100,000
Transport to Dewatering Pads	217800	tons	2	$435,600
Separate Solids	217800	tons	10	$2,178,000
Place Soils in Trucks	130680	tons	10	$1,306,800
Transport to On-site Thermal Treatment Plant	130680	tons	2	$261,360
On-site Thermal Treatment	130680	tons	45	$5,880,600
Treatment Samples	1000	ea	100	$100,000
Shred Wood Materials	30000	tons	10	$300,000
Placement in Trucks	30000	tons	2	$60,000
Transport to Power Plant	30000	tons	2	$60,000
Co-burning Wood as Fuel (credit)	30000	tons	-5	($150,000)
Backfill and Compact Treated Soils	130680	tons	3	$392,040
Backfill and Compact Clean Sand	87120	tons	7	$609,840
Subtotal:				**$16,326,240**

Excavated Solids Dewatering & Separation System	quantity	unit	unit cost $	subtotal $
Dewatering & Treatment Pad w/ Berm	5000	sf	5	$25,000
Density Separator System	1	ls	1000000	$1,000,000
Wood Shredder System	1	ls	1000000	$1,000,000
Liquid Collection Sump	1	ls	2000	$2,000
Discharge Pump	2	ea	1000	$2,000
Discharge Piping	500	lf	10	$5,000
Pump Controls and Electrical	1	ls	2000	$2,000
Temporary Structure	1	ls	40000	$40,000
Air collection and Treatment system	1	ls	100000	$100,000
OM&M Costs (power, carbon, monitoring, labor)	3	yr	100000	$300,000
Subtotal:				**$2,476,000**

Sitework 100 GPM Water Collection/Treatment System	quantity	unit	unit cost $	subtotal $
Treatment Building Renovation	1	ls	100000	$100,000
Settling Tank	1	ea	9000	$9,000
NAPL separator & storage tank	1	ea	12000	$12,000
Oleophilic Filter	1	ea	5000	$5,000
DAF system	1	ls	250000	$250,000
VOC and SVOC removal system	1	ls	80000	$80,000
Suspended Solids Filter	1	ea	15000	$15,000
Liquid Phase GAC Polishing System	1	ea	15000	$15,000
Transfer Pumps, 100 gpm	4	ea	1500	$6,000
Flowmeters	4	ea	1000	$4,000
Misc Piping, Valves, and Fittings	1	ls	20000	$20,000
Cleaning System	1	ls	20000	$20,000
Instrumentation and Control System	1	ls	20000	$20,000
Misc Electrical	1	ls	20000	$20,000
Discharge Piping, 4" PVC	50	lf	5	$250
Trenching, Backfill, & Compaction, 4 ft deep	50	lf	16	$800
Connection to Sanitary Lift Station	1	ls	2000	$2,000
OM&M Costs (power, carbon, monitoring, labor)	8	yr	40000	$320,000
Sanitary Discharge Fee	138,240	x1000 gal	2	$276,480
Subtotal:				**$1,175,530**

WWTP Cell Treatment System	quantity	unit	unit cost $	subtotal $
GW Pumps	5	ea	2000	$10,000
50 cfm blower and air treatment system	1	ls	100000	$100,000
10 gpm treatment system	1	ls	80000	$80,000
Wells	5	ea	2000	$10,000
Subtotal:				**$200,000**

Site Restoration	quantity	unit	unit cost $	subtotal $
Clean Fill, placed & compacted	21780	tons	15	$326,700
Topsoil, placed and graded	10890	tons	10	$108,900
Seeding	10	ac	100	$1,000
New Trees	200	ea	200	$40,000
Pedestrian Walkway	1500	lf	25	$37,500
Road	45000	sf	5	$225,000
Shoreline	1500	tons	200	$300,000
Subtotal:				**$1,039,100**

Monitoring System	quantity	unit	unit cost $	subtotal $
Monitoring Wells	10	ea	1000	$10,000
Oleophilic Sumps	2	ea	3000	$6,000
Subtotal:				**$16,000**

	quantity	unit	unit cost	subtotal
Annual GW Cutoff System O&M Costs			**$**	**$**
O&M Labor	144	hrs	50	$7,200
Power (75 hp * 365 days)	490779	kwhrs	0.06	$29,447
Parts Replacement	1	ls	10000	$10,000
Sanitary Disposal Fees	5256	1000 GAL	1	$5,256
NAPL Disposal Offsite	1000	gal	2	$2,000
Sludge Disposal Offsite	22	tons	50	$1,100
Carbon Replacement & Disposal	1000	lbs	5	$5,000
Bag Filter Disposal	1	ls	500	$500
O&M Status Reports	64	hrs	70	$4,480
Subtotal:				**$64,983**

	quantity	unit	unit cost	subtotal
Annual WWTP Cell System O&M Costs			**$**	**$**
O&M Labor	144	hrs	50	$7,200
Power (75 hp * 365 days)	490779	kwhrs	0.06	$29,447
Parts Replacement	1	ls	10000	$10,000
Sanitary Disposal Fees	5256	1000 GAL	1	$5,256
NAPL Disposal Offsite	50	gal	2	$100
Sludge Disposal Offsite	1	tons	50	$50
Carbon Replacement & Disposal	1000	lbs	5	$5,000
Bag Filter Disposal	1	ls	500	$500
O&M Status Reports	64	hrs	70	$4,480
Subtotal:				**$62,033**

	quantity	unit	unit cost	subtotal
Annual Remediation System Performance Monitoring Costs			**$**	**$**
Sampling Labor	96	hrs	50	$4,800
Equipment	24	days	500	$12,000
Lab Analyses	96	sample	200	$19,200
Status Reports	128	hrs	70	$8,960
Subtotal:				**$44,960**

	quantity	unit	unit cost	subtotal
Annual Site Monitoring (4 Quarters)			**$**	**$**
Well development labor	160	hrs	50	$8,000
Analyses -6 monitoring points	40	samples	250	$10,000
Sampling Labor (GW samples)	80	hrs	50	$4,000
Equipment	4	days	500	$2,000
Reporting	64	hrs	70	$4,480
Subtotal:				**$28,480**

	quantity	unit	unit cost	subtotal
Annual Site Maintenance			**$**	**$**
General	1	ls	5000	$5,000
Subtotal:				**$5,000**

Feasibility Study Cost Projections
Remedial Action Option #E2: Phased Dredging/Excavation with Stabilization and Off-site Disposal. Backfill with Clean Fill.
Project: Ashland Lakefront - Comprehensive FS
SEH# WIDNR9401

CALC'D 'BY: MJB	18 Nov 98
CHECKED BY: GPW	8 Dec 98

PRELIMINARY COST PROJECTION SUMMARY - RAO#E2

Remedial Action Initial Capital Costs:

Upgradient Cutoff Trench, Pumping, &10 gpm Treatment System		$1,237,100	
Side& Shoreline Cutoff Walls		$2,520,000	
Breakwater 2900N & Cutoff wall		$2,250,000	
Utility Rerouting		$93,000	
Sediment Dredging		$7,255,000	
Sediment Treatment		$20,746,600	
Landside pretreatment		$1,500,000	
Excavation, Transportation, and Treatment/Disposal		$18,940,100	
Excavated Solids Dewatering & Separation System		$501,000	
Sitework 100 GPM Water Collection/Treatment System		$1,175,530	
WWTP Cell Treatment System		$200,000	
Site Restoration		$712,400	
Monitoring System		$16,000	
Subtotal:		$57,146,730	
Contingency	20%	$11,429,346	
Subtotal:		$68,576,076	
Planning and Permitting:	5%	$3,428,804	
Pilot Tests	5%	$3,428,804	
Engineering	7%	$4,800,325	
Construction Oversight	7%	$4,800,325	
Subtotal, Remedial Action Initial Capital Costs:			$85,034,334
Subtotal,Initial Capital Costs:			**$85,034,334**

Long Term Operations, Maintenance, and Monitoring Costs:

Annual GW Cutoff System O&M Costs		$64,979
Annual WWTP Cell System O&M Costs		$62,033
Annual Performance Monitoring O&M Costs		$44,960
Annual Site Monitoring (4 Quarters)		$28,480
Annual Site Maintenance		$5,000
Subtotal:		$205,451
Contingency	25%	$51,363
Subtotal Annual OM&M Costs:		**$256,814**

Capitalized Costs:

Long Term Operation Period, n (years)	40 years
Average Net Interest Rate, i	5%
Present Worth Factor (i, n)	17.159
Annual OM&M Costs:	$256,814
Present Worth Long Term OM&M Costs	$4,406,697
Initial Capital Costs:	$85,034,334
Capitalized Total Costs:	**$89,441,031**

Annualized Costs:

Long Term Operation Period, n (years)	40 years
Average Interest Rate, i	5%
Amortization Factor (i, n)	0.058
Initial Capital Costs:	$85,034,334
Amortized Capital Costs:	$4,955,645
Annual OM&M Costs:	$256,814
Annualized Total Costs:	**$5,212,459**

Upgradient Cutoff Trench, Pumping, &10 gpm Treatment System	quantity	unit	unit cost $	subtotal $
Impermeable Liner, 15 ft deep, 1100 lf	16500	sf	40	$660,000
Trench Excavation, 10 ft deep	1100	lf	50	$55,000
Contaminated Soil Disposal	5500	tons	50	$275,000
Trench Filter Fabric	5000	sf	2	$10,000
Gravel Backfill	5500	tons	10	$55,000
Collection Pipe, 4" HDPE perforated	1100	lf	2	$2,200
Collection Sump	1	ls	2000	$2,000
Sump Pump, 10 gpm	1	ls	3000	$3,000
Sump Level Controls	1	ls	2000	$2,000
Electrical Conduit	1400	lf	5	$7,000
Conveyance Piping	700	lf	2	$1,400
Trenching, Backfill, & Compaction, 5 ft deep	700	lf	20	$14,000
Treatment System Building	1	ls	30000	$30,000
Settling Tank	1	ea	3000	$3,000
NAPL separator & storage tank	1	ea	3000	$3,000
Oleophilic Filter	1	ea	1000	$1,000
VOC and SVOC removal system	1	ls	40000	$40,000
Liquid Phase GAC Polishing System	1	ea	8000	$8,000
Transfer Pumps	4	ea	1000	$4,000
Flowmeters	4	ea	500	$2,000
Misc Piping, Valves, and Fittings	1	ls	5000	$5,000
Cleaning System	1	ls	5000	$5,000
Instrumentation and Control System	1	ls	7000	$7,000
Misc Electrical	1	ls	5000	$5,000
Discharge Piping, 4" PVC	500	lf	5	$2,500
Trenching, Backfill, & Compaction, 4 ft deep	500	lf	16	$8,000
Surface Restoration	1	ls	5000	$5,000
Connection to Sanitary Pump Station	1	ls	2000	$2,000
Startup Samples	100	ea	200	$20,000
Subtotal:				**$1,237,100**

Side& Shoreline Cutoff Walls	quantity	unit	unit cost $	subtotal $
West Sheetpiling, 15 feet deep, 1200 lf	18000	sf	40	$720,000
East Sheetpiling, 15 feet deep, 1000 lf	15000	sf	40	$600,000
North Sheetpiling, 20 feet deep, 1500 lf	30000	sf	40	$1,200,000
Subtotal:				**$2,520,000**

Breakwater 2900N & Cutoff wall	quantity	unit	unit cost $	subtotal $
Rubble mound Breakwater, 15' deep	1500	lf	1500	$2,250,000
Subtotal:				**$2,250,000**

Utility Rerouting	quantity	unit	unit cost $	subtotal $
2nd St Storm Sewer	500	lf	80	$40,000
3d St Storm sewer	500	lf	80	$40,000
Phone	1	ls	5000	$5,000
Power	1	ls	5000	$5,000
Water	1	ls	1500	$1,500
Gas	1	ls	1500	$1,500
Subtotal:				**$93,000**

Sediment Dredging	quantity	unit	unit cost $	subtotal $
Cutoff and Remove Old Pilings	40	ea	1000	$40,000
Remove existing shoreline riprap	7500	tons	20	$150,000
Hydraulic Dredging	217800	tons	25	$5,445,000
Mechanical Dredging, Standby	720	days	1000	$720,000
Confirmation Samples	1000	ea	100	$100,000
Temporary barriers	80000	sf	10	$800,000
Subtotal:				**$7,255,000**

Sediment Treatment	quantity	unit	unit cost $	subtotal $
Renovate WWTP building	1	ls	200000	$200,000
Pumps & Piping	1	ls	100000	$100,000
Controls	1	ls	20000	$20,000
Power Hookup	1	ls	10000	$10,000
Coarse sand dewatering basin	1	ls	40000	$40,000
Flocculent tank & mixer	1	ls	60000	$60,000
Filter Press	1	ls	200000	$200,000
Air Treatment Equipment	1	ls	200000	$200,000
Processing	720	days	1000	$720,000
Sediment Slurry Processing	200,000,000	gallons	0.05	$10,000,000
Stabilization	217800	tons	10	$2,178,000
Place in Trucks	217800	tons	10	$2,178,000
Transport to Rail cars	217800	tons	2	$435,600
Railcar to Landfill	217800	tons	10	$2,178,000
Landfill Disposal	217800	tons	15	$3,267,000
Treatment Samples	5000	ea	100	$500,000
Dispose of NAPL offsite	5000	gal	2	$10,000
Subtotal:				**$20,746,600**

Landside pretreatment	quantity	unit	unit cost $	subtotal $
Dewatering	10	ac	50000	$500,000
Air Sparging	10	ac	50000	$500,000
Soil Vapor Extraction	10	ac	50000	$500,000
Subtotal:				**$1,500,000**

Excavation, Transportation, and Treatment/Disposal	quantity	unit	unit cost $	subtotal $
Site Preparation - Clearing & Stripping	10	ac	1500	$15,000
Temporary Structure	2	ea	150000	$300,000
Air Collection and Treatment System	2	ea	50000	$100,000
OM&M Costs (power, carbon, monitoring, labor,cleaning)	3	yr	150000	$450,000
Temporary Sheetpiling, 15 ft deep, two 1100 lf walls	33000	sf	20	$660,000
Excavation	217800	tons	15	$3,267,000
Transport to Dewatering/Stabilization Pads	217800	tons	2	$435,600
Stabilize	217800	tons	10	$2,178,000
Transport to Railcar	283140	tons	10	$2,831,400
Rail to Landfill	283140	tons	10	$2,831,400
Landfill Disposal	283140	tons	15	$4,247,100
Confirmatory Samples	1000	ea	100	$100,000
Backfill and Compact Clean Sand	217800	tons	7	$1,524,600
Subtotal:				**$18,940,100**

Excavated Solids Dewatering & Separation System	quantity	unit	unit cost $	subtotal $
Dewatering & Treatment Pad w/ Berm	10000	sf	5	$50,000
Liquid Collection Sump	1	ls	2000	$2,000
Discharge Pump	2	ea	1000	$2,000
Discharge Piping	500	lf	10	$5,000
Pump Controls and Electrical	1	ls	2000	$2,000
Temporary Structure	1	ls	40000	$40,000
Air collection and Treatment system	1	ls	100000	$100,000
OM&M Costs (power, carbon, monitoring, labor)	3	yr	100000	$300,000
Subtotal:				**$501,000**

	quantity	unit	unit cost	subtotal
Sitework 100 GPM Water Collection/Treatment System			**$**	**$**
Treatment Building Renovation	1	ls	100000	$100,000
Settling Tank	1	ea	9000	$9,000
NAPL separator & storage tank	1	ea	12000	$12,000
Oleophilic Filter	1	ea	5000	$5,000
DAF System	1	ls	250000	$250,000
VOC and SVOC removal system	1	ls	80000	$80,000
Suspended Solids Filter	1	ea	15000	$15,000
Liquid Phase GAC Polishing System	1	ea	15000	$15,000
Transfer Pumps, 100 gpm	4	ea	1500	$6,000
Flowmeters	4	ea	1000	$4,000
Misc Piping, Valves, and Fittings	1	ls	20000	$20,000
Cleaning System	1	ls	20000	$20,000
Instrumentation and Control System	1	ls	20000	$20,000
Misc Electrical	1	ls	20000	$20,000
Discharge Piping, 4" PVC	50	lf	5	$250
Trenching, Backfill, & Compaction, 4 ft deep	50	lf	16	$800
Connection to Sanitary Lift Station	1	ls	2000	$2,000
OM&M Costs (power, carbon, monitoring, labor)	8	yr	40000	$320,000
Sanitary Discharge Fee	138,240	x1000 gal	2	$276,480
Subtotal:				**$1,175,530**

	quantity	unit	unit cost	subtotal
WWTP Cell Treatment System			**$**	**$**
GW Pumps	5	ea	2000	$10,000
50 cfm blower and air treatment system	1	ls	100000	$100,000
10 gpm treatment system	1	ls	80000	$80,000
Wells	5	ea	2000	$10,000
Subtotal:				**$200,000**

	quantity	unit	unit cost	subtotal
Site Restoration			**$**	**$**
Topsoil, placed and graded	10890	tons	10	$108,900
Seeding	10	ac	100	$1,000
New Trees	200	ea	200	$40,000
Pedestrian Walkway	1500	lf	25	$37,500
Road	45000	sf	5	$225,000
Shoreline	1500	tons	200	$300,000
Subtotal:				**$712,400**

	quantity	unit	unit cost	subtotal
Monitoring System			**$**	**$**
Monitoring Wells	10	ea	1000	$10,000
Oleophilic Sumps	2	ea	3000	$6,000
Subtotal:				**$16,000**

	quantity	unit	unit cost	subtotal
Annual GW Cutoff System O&M Costs			$	$
O&M Labor	144	hrs	50	$7,200
Power (75 hp * 365 days)	490779	kwhrs	0.06	$29,447
Parts Replacement	1	ls	10000	$10,000
Sanitary Disposal Fees	5256	1000 GAL	1	$5,256
NAPL Disposal Offsite	1000	gal	2	$2,000
Sludge Disposal Offsite	22	tons	50	$1,096
Carbon Replacement & Disposal	1000	lbs	5	$5,000
Bag Filter Disposal	1	ls	500	$500
O&M Status Reports	64	hrs	70	$4,480
Subtotal:				**$64,979**

	quantity	unit	unit cost	subtotal
Annual WWTP Cell System O&M Costs			$	$
O&M Labor	144	hrs	50	$7,200
Power (75 hp * 365 days)	490779	kwhrs	0.06	$29,447
Parts Replacement	1	ls	10000	$10,000
Sanitary Disposal Fees	5256	1000 GAL	1	$5,256
NAPL Disposal Offsite	50	gal	2	$100
Sludge Disposal Offsite	1	tons	50	$50
Carbon Replacement & Disposal	1000	lbs	5	$5,000
Bag Filter Disposal	1	ls	500	$500
O&M Status Reports	64	hrs	70	$4,480
Subtotal:				**$62,033**

	quantity	unit	unit cost	subtotal
Annual Performance Monitoring O&M Costs			$	$
Sampling Labor	96	hrs	50	$4,800
Equipment	24	days	500	$12,000
Lab Analyses	96	sample	200	$19,200
Status Reports	128	hrs	70	$8,960
Subtotal:				**$44,960**

	quantity	unit	unit cost	subtotal
Annual Site Monitoring (4 Quarters)			$	$
Well development labor	160	hrs	50	$8,000
Analyses -10 monitoring points	40	samples	250	$10,000
Sampling Labor (GW samples)	80	hrs	50	$4,000
Equipment	4	days	500	$2,000
Reporting	64	hrs	70	$4,480
Subtotal:				**$28,480**

	quantity	unit	unit cost	subtotal
Annual Site Maintenance			$	$
General	1	ls	5000	$5,000
Subtotal:				**$5,000**

Feasibility Study Cost Projections
Remedial Action Option #E3: Phased Dredging/Excavation with Stabilization and Off-site Disposal. No Backfill.
Project: Ashland Lakefront - Comprehensive FS
SEH# WIDNR9401

CALC'D 'BY: MJB 18 Nov 1998
CHECKED BY: 9 Dec 98

PRELIMINARY COST PROJECTION SUMMARY - RAO#E3

Remedial Action Initial Capital Costs:

Upgradient Cutoff Trench, Pumping, &10 gpm Treatment System		$1,217,500	
Side& Shoreline Cutoff Walls		$2,520,000	
Breakwater 2900N & Cutoff wall		$2,250,000	
Utility Rerouting		$93,000	
Sediment Dredging		$7,255,000	
Sediment Treatment		$17,479,600	
Landside pretreatment		$1,500,000	
Excavation, Transportation, and Treatment/Disposal		$17,012,918	
Excavated Solids Dewatering & Separation System		$501,000	
Sitework 100 GPM Water Collection/Treatment System		$1,150,530	
New Shoreline		$337,500	
Monitoring System		$16,000	
Subtotal:		$51,333,048	
Contingency	20%	$10,266,610	
Subtotal:		$61,599,658	
Planning and Permitting:	5%	$3,079,983	
Pilot Tests	5%	$3,079,983	
Engineering	7%	$4,311,976	
Construction Oversight	7%	$4,311,976	
Subtotal, Remedial Action Initial Capital Costs:			$76,383,575
Subtotal,Initial Capital Costs:			**$76,383,575**

Long Term Operations, Maintenance, and Monitoring Costs:

Annual GW Cutoff System O&M Costs		$64,979
Annual Remediation System Performance Monitoring Costs		$22,480
Annual Site Monitoring (4 Quarters)		$19,680
Annual Site Maintenance		$5,000
Subtotal:		$112,139
Contingency	25%	$28,035
Subtotal Annual OM&M Costs:		**$140,173**

Capitalized Costs:

Long Term Operation Period, n (years)	40 years
Average Net Interest Rate, i	5%
Present Worth Factor (i, n)	17.159
Annual OM&M Costs:	$140,173
Present Worth Long Term OM&M Costs	$2,405,245
Initial Capital Costs:	$76,383,575
Capitalized Total Costs:	**$78,788,821**

Annualized Costs:

Long Term Operation Period, n (years)	40 years
Average Interest Rate, i	5%
Amortization Factor (i, n)	0.058
Initial Capital Costs:	$76,383,575
Amortized Capital Costs:	$4,451,494
Annual OM&M Costs:	$140,173
Annualized Total Costs:	**$4,591,668**

	quantity	unit	unit cost	subtotal
Upgradient Cutoff Trench, Pumping, &10 gpm Treatment System			$	$
Impermeable Liner, 15 ft deep, 1100 lf	16500	sf	40	$660,000
Trench Excavation, 10 ft deep	1100	lf	50	$55,000
Contaminated Soil Disposal	5500	tons	50	$275,000
Trench Filter Fabric	5000	sf	2	$10,000
Gravel Backfill	5500	tons	10	$55,000
Collection Pipe, 4" HDPE perforated	1100	lf	2	$2,200
Collection Sump	1	ls	2000	$2,000
Sump Pump, 10 gpm	1	ls	2000	$2,000
Sump Level Controls	1	ls	1000	$1,000
Electrical Conduit	1400	lf	5	$7,000
Conveyance Piping	700	lf	2	$1,400
Trenching, Backfill, & Compaction, 5 ft deep	700	lf	20	$14,000
Treatment System Building	1	ls	30000	$30,000
Settling Tank	1	ea	3000	$3,000
NAPL separator & storage tank	1	ea	3000	$3,000
Oleophilic Filter	1	ea	1000	$1,000
VOC and SVOC removal system	1	ls	40000	$40,000
Liquid Phase GAC Polishing System	1	ea	8000	$8,000
Transfer Pumps	4	ea	1000	$4,000
Flowmeters	4	ea	500	$2,000
Misc Piping, Valves, and Fittings	1	ls	5000	$5,000
Cleaning System	1	ls	5000	$5,000
Instrumentation and Control System	1	ls	7000	$7,000
Misc Electrical	1	ls	5000	$5,000
Discharge Piping, 4" PVC	500	lf	5	$2,500
Trenching, Backfill, & Compaction, 4 ft deep	500	lf	16	$8,000
Surface Restoration	1	ls	5000	$5,000
Connection to Sanitary Pump Station	1	ls	2000	$2,000
Startup Samples	12	ea	200	$2,400
Subtotal:				**$1,217,500**

	quantity	unit	unit cost	subtotal
Side& Shoreline Cutoff Walls			$	$
West Sheetpiling, 15 feet deep, 1200 lf	18000	sf	40	$720,000
East Sheetpiling, 15 feet deep, 1000 lf	15000	sf	40	$600,000
North Sheetpiling, 20 feet deep, 1500 lf	30000	sf	40	$1,200,000
Subtotal:				**$2,520,000**

	quantity	unit	unit cost	subtotal
Breakwater 2900N & Cutoff wall			$	$
Rubble mound Breakwater, 15' deep	1500	lf	1500	$2,250,000
Subtotal:				**$2,250,000**

	quantity	unit	unit cost	subtotal
Utility Rerouting			$	$
2nd St Storm Sewer	500	lf	80	$40,000
3d St Storm sewer	500	lf	80	$40,000
Phone	1	ls	5000	$5,000
Power	1	ls	5000	$5,000
Water Piping	1	ls	1500	$1,500
Gas	1	ls	1500	$1,500
Subtotal:				**$93,000**

	quantity	unit	unit cost	subtotal
Sediment Dredging			$	$
Cutoff and Remove Old Pilings	40	ea	1000	$40,000
Remove existing shoreline riprap	7500	tons	20	$150,000
Hydraulic Dredging	217800	tons	25	$5,445,000
Mechanical Dredging, Standby	720	days	1000	$720,000
Confirmatory Samples	1000	ea	100	$100,000
Temporary barriers	80000	sf	10	$800,000
Subtotal:				**$7,255,000**

	quantity	unit	unit cost	subtotal
Sediment Treatment			$	$
Renovate WWTP building	1	ls	200000	$200,000
Pumps & Piping	1	ls	100000	$100,000
Controls	1	ls	20000	$20,000
Power Hookup	1	ls	10000	$10,000
Coarse sand dewatering basin	1	ls	40000	$40,000
Flocculent tank & mixer	1	ls	60000	$60,000
Filter Press	1	ls	200000	$200,000
Air Treatment Equipment	1	ls	200000	$200,000
Processing	720	days	1000	$720,000
Sediment Slurry Processing	200,000,000	gallons	0.05	$10,000,000
Place in Trucks	217800	tons	10	$2,178,000
Transport to Rail cars	217800	tons	2	$435,600
Railcar to Landfill	217800	tons	5	$1,089,000
Landfill Disposal	217800	tons	15	$3,267,000
Treatment Samples	5000	ea	100	$500,000
Dispose of NAPL offsite	5000	gal	2	$10,000
Subtotal:				**$17,479,600**

	quantity	unit	unit cost	subtotal
Landside pretreatment			$	$
Dewatering	10	ac	50000	$500,000
Air Sparging	10	ac	50000	$500,000
Soil Vapor Extraction	10	ac	50000	$500,000
Subtotal:				**$1,500,000**

	quantity	unit	unit cost	subtotal
Excavation, Transportation, and Treatment/Disposal			$	$
Site Preparation - Clearing & Stripping	10	ac	1500	$15,000
Temporary Structure	2	ea	150000	$300,000
Air Collection and Treatment System	2	ea	50000	$100,000
OM&M Costs (power, carbon, monitoring, labor,cleaning)	3	yr	150000	$450,000
Temporary Sheetpiling, 15 ft deep, two 1100 lf walls	33000	sf	20	$660,000
Building Demolition	1	ls	500000	$500,000
Excavation	239580	tons	15	$3,593,700
Confirmatory Samples	1100	ea	100	$110,000
Transport to Dewatering/Stabilization Pads	239580	tons	2	$479,160
Stabilize	239580	tons	10	$2,395,800
Transport to Railcar	311454	tons	2	$622,908
Rail to Landfill	311454	tons	10	$3,114,540
Landfill Disposal	311454	tons	15	$4,671,810
Subtotal:				**$17,012,918**

	quantity	unit	unit cost	subtotal
Excavated Solids Dewatering & Separation System			$	$
Dewatering & Treatment Pad w/ Berm	10000	sf	5	$50,000
Liquid Collection Sump	1	ls	2000	$2,000
Discharge Pump	2	ea	1000	$2,000
Discharge Piping	500	lf	10	$5,000
Pump Controls and Electrical	1	ls	2000	$2,000
Temporary Structure	1	ls	40000	$40,000
Air collection and Treatment system	1	ls	100000	$100,000
OM&M Costs (power, carbon, monitoring, labor)	3	yr	100000	$300,000
Subtotal:				**$501,000**

	quantity	unit	unit cost	subtotal
Sitework 100 GPM Water Collection/Treatment System			**$**	**$**
Treatment System Building	1	ls	75000	$75,000
Settling Tank	1	ea	9000	$9,000
NAPL separator & storage tank	1	ea	12000	$12,000
Oleophilic Filter	1	ea	5000	$5,000
DAF System	1	ls	250000	$250,000
VOC and SVOC removal system	1	ls	80000	$80,000
Suspended Solids Filter	1	ea	15000	$15,000
Liquid Phase GAC Polishing System	1	ea	15000	$15,000
Transfer Pumps, 100 gpm	4	ea	1500	$6,000
Flowmeters	4	ea	1000	$4,000
Misc Piping, Valves, and Fittings	1	ls	20000	$20,000
Cleaning System	1	ls	20000	$20,000
Instrumentation and Control System	1	ls	20000	$20,000
Misc Electrical	1	ls	20000	$20,000
Discharge Piping, 4" PVC	50	lf	5	$250
Trenching, Backfill, & Compaction, 4 ft deep	50	lf	16	$800
Connection to Sanitary Lift Station	1	ls	2000	$2,000
OM&M Costs (power, carbon, monitoring, labor)	8	yr	40000	$320,000
Sanitary Discharge Fee	138,240	x1000 gal	2	$276,480
Subtotal:				**$1,150,530**

	quantity	unit	unit cost	subtotal
New Shoreline			**$**	**$**
Pedestrian Walkway	1500	lf	25	$37,500
Shoreline	1500	lf	200	$300,000
Subtotal:				**$337,500**

	quantity	unit	unit cost	subtotal
Monitoring System			**$**	**$**
Monitoring Wells	10	ea	1000	$10,000
Oleophilic Sumps	2	ea	3000	$6,000
Subtotal:				**$16,000**

	quantity	unit	unit cost	subtotal
Annual GW Cutoff System O&M Costs			**$**	**$**
O&M Labor	144	hrs	50	$7,200
Power (75 hp * 365 days)	490779	kwhrs	0.06	$29,447
Parts Replacement	1	ls	10000	$10,000
Sanitary Disposal Fees	5256	1000 GAL	1	$5,256
NAPL Disposal Offsite	1000	gal	2	$2,000
Sludge Disposal Offsite	22	tons	50	$1,096
Carbon Replacement & Disposal	1000	lbs	5	$5,000
Bag Filter Disposal	1	ls	500	$500
O&M Status Reports	64	hrs	70	$4,480
Subtotal:				**$64,979**

	quantity	unit	unit cost	subtotal
Annual Remediation System Performance Monitoring Costs			**$**	**$**
Sampling Labor	48	hrs	50	$2,400
Equipment	12	days	500	$6,000
Lab Analyses	48	sample	200	$9,600
Status Reports	64	hrs	70	$4,480
Subtotal:				**$22,480**

	quantity	unit	unit cost	subtotal
Annual Site Monitoring (4 Quarters)			**$**	**$**
Well development labor	96	hrs	50	$4,800
Analyses -6 monitoring points	24	samples	250	$6,000
Sampling Labor (GW samples)	48	hrs	50	$2,400
Equipment	4	days	500	$2,000
Reporting	64	hrs	70	$4,480
Subtotal:				**$19,680**

	quantity	unit	unit cost	subtotal
Annual Site Maintenance			**$**	**$**
General	1	ls	5000	$5,000
Subtotal:				**$5,000**